ECONOMIC PRODUCTS

OF THE

NORTH-WEST PROVINCES.

PART III.

DYES AND TANS.

COMPILED IN THE DEPARTMENT OF AGRICULTURE AND COMMERCE, N.-W. P. AND OUDH.

ALLAHABAD:

NORTH-WESTERN PROVINCES AND OUDH GOVERNMENT PRESS.

1878.

INTRODUCTION.

THIS volume forms the third of a series of compilations of the Economic Products of the North-Western Provinces, of which the first two are—

Gums and Resins of the North-Western Provinces,
Minerals of the North-Western Provinces,

by E. T. Atkinson, Esq., C.S.

In a Circular No. $\frac{2}{4}\frac{2}{3}$, dated 25th May, 1875, the Government of India called for an account of the Dyes and Tans in each Province, and the present volume was originated in collecting the information required by the orders above quoted.

In the compilation now published I have received much aid from my Assistant, Mr. J. B. Fuller, and from the Head Superintendent of my office, Babu Trailokya Náth Mukharji.

E. C. BUCK,

Dir., Agri. and Com., N.-W. P. and Oudh.

September 1st, 1878.

DYEING AND TANNING SUBSTANCES

OF THE

NORTH-WEST PROVINCES,

WITH THE METHODS OF THEIR USE.

THE following is the order in which the different heads of this Report have been grouped :—

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     - (*a*) Dyes and colouring matters.
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PART I.—DYEING SUBSTANCES

OF THE

NORTH-WEST PROVINCES, WITH THE METHODS OF THEIR ORDINARY USE.

SECTION I.—DYE SUBSTANCES USED AND PRODUCED IN THE N.-W. P.

A.—OF VEGETABLE ORIGIN.

THE vegetable dye substances used in the North-West Provinces of India may be broadly divided into two classes: the *first* comprising those which are obtained from plants cultivated for the sake of the dye they yield, the *second* including those obtained from plants or trees either growing wild or cultivated mainly for the sake of some other product.

The dyes included in the first class are few in number, though out of all comparison the more important; in the second class are grouped a great number of substances which are in general undeserving of much attention from a commercial point of view; in most cases their use is confined to classes who cannot afford the more expensive dyes of commerce, and, with a few exceptions, their qualities are not such as to give grounds for any hope of their ever becoming articles of regular trade.

I. A. (1)—VEGETABLE DYE SUBSTANCES PRODUCED IN THE NORTH-WEST PROVINCES DERIVED FROM CULTIVATED PLANTS.

The cultivated vegetable dyes of these provinces are, in the order of their importance—

English name.	*Vernacular name.*	*Botanical name of plants whence derived.*	*English name.*	*Vernacular name.*	*Botanical name of plants whence derived.*
Indigo	... *Nil*	... Indigofera tinctoria.	*None*	... *Al*	... Morinda citrifolia.
Safflower	... *Kusum or kar* ...	Carthamus tinctorius	Madder	... *Manjit*	... Rubia cordifolia.
			Turmeric	... *Haldi*	... Curcuma longa.

(1) Indigo. (Ver. Nil.) A dark-blue dye obtained from the leaves of Indigofera tinctoria; *Nat. Ord. Leguminosæ.*

Description.—Shrub, 2-3 feet, erect, pubescent; branches terete, firm; leaves pinnated; leaflets 5-6 pairs, oblong-ovate, cuneate at the base, slightly decreasing in size towards the apex of the leaf; racemes shorter than the leaves, sessile, many-flowered; flowers small, approximated at the base of the raceme, more distant and deciduous towards the apex, greenish-rose colour; calyx 5-cleft, segments broad, acute; legumes approximated towards the base of the rachis, nearly cylindrical, slightly torulose, deflexed and curved upwards; seeds about 10, cylindrical, truncated at both ends (Drury.)

Method of cultivation.

The indigo plant is cultivated to a greater or less extent in almost all the non-mountainous districts of the North-West Provinces, but most extensively in those districts where canal irrigation is available.

(1) INDIGO.

Indigo dye is derived from a glucoside compound known as indican, which occurs in the leaves of certain plants of the genera *Isatis* and *Indigofera:* to the former genus belongs the woad *(Isatis tinctoria)*; of the latter there are several species which are grown in different parts of the world for the sake of the dye they yield. *Indigofera tinctoria* is the one generally grown in these provins. Indican is occasionally found in the leaves of plants outside these two general; an example is afforded by the Indian plant *Wrightia tinctoria.*

Advance system.

It is grown by cultivators either on their own account or on the account of capitalists, from whom they generally receive advances to meet the expenses of cultivation, and to whom they are under an obligation to sell all the plants produced at a fixed rate. The different forms of agreement which are made between capitalist (or "planter") and cultivator at the time the advance is made do not need notice in the present report, nor need the effects of such a system be enlarged upon here. Suffice it to say that with all its disadvantages the system is the only means of bringing about the application of extraneous capital to land, without which the cultivation of indigo would often be impossible.

Cultivation in the Cawnpore district.

The following account of the cultivation of indigo is taken (with slight modifications) from Mr. Wright's Memorandum on the Agriculture of the Cawnpore District. With a few alterations, it applies to the greater part of the North-West Provinces, where irrigation is available* :—

Indigo.

Name of crop.	Statistics per acre.							
	Ploughings.	Time of sowing.	Seed sown.	Weeding.	Watering.	Cutting.	*Outturn.* Plant.	*Outturn.* Seeds.
Nil ...	2 to 4	Chait, (March.)	4 or 5 seers	Once	4	16 to 20 men for one day.	50 to 80 mds. or 100 „	5 maunds or 8 „
Subordinate.								
Arhar ...	...	...	4 seers ...	...	...	...	2 maunds (grain)	5 maunds bhúsa and stalks.
Castor-oil ...	...	...	1 seer ...	...	...	...	20 srs. (oil-seed)	
Hemp ...	...	...	1 „ ...	...	...	...	10 srs. (fibre)	

Varieties. Not cultivated in North-West Provinces.

Preparation of land. "The field is not manured, but it is best to sow the year after a manured "crop like cotton. It must be prepared by watering (*pareh*) "before ploughing for sowing.

* For account of cultivation where irrigation is not available see appendix I.

"The ploughing, sowing, levelling, after-sowing, and making the irrigation "beds, are all done in one day whilst the ground is moist: "the cultivator borrows ploughs to help him, and his hired "labourers work all day. The seed is sown broadcast and ploughed in, the "*mai* being run over afterwards.

Ploughing, sowing.

"The plants show in a week, and must be watered at once, and every fort- "night afterwards till the rain falls. When the plant is two "finger-joints high (*porua*), and whilst the ground is moist, "but not wet, a weeding is given, which must be finished in a day or two at "the outside. Old women or children are usually employed in this, and get "1¼ anna and *chabena* (parched gram). Rain sowings require weeding more "than earlier sowings, as the plant whilst still young is liable to be choked "by the grass that springs up in the early rains.

Intermediate operations.

"For plant (for dye) the indigo should be cut in August, just when the "flower bud begins to show; 16 or 20 men will cut an acre "in one day. The carriage to the vats is a matter of con- "tract with the factory. The stumps are left for seed, or where there is no fac- "tory, the whole crop is left for seed and is cut at the end of November.

Cutting.

"Outturn of indigo varies: as much as 80 to 120 maunds plant per acre "may be cut for the factory; but the cultivator cutting for "his own rough manufacture will perhaps cut as little as 50 "maunds plant, leaving the stocks for seed, of which he will get 5 maunds. "If he grows for seed alone he may expect 8 maunds per acre.

Outturn.

"*Cost of production.*

Cost per acre.	Well.	Cost by canal, one lift.	Canal flush.	Produce.	Value.
	Rs. a. p.	Rs. a. p.	Rs. a. p.		Rs. a. p.
Watering (before ploughing).	5 4 0	1 5 0	0 3 0	Plants 50 maunds, at 5 maunds per rupee.	10 0 0
Ploughing and sowing ...	0 12 6	0 12 6	0 12 6		
Seed	1 10 6	1 10 6	1 10 6	Seed 5 maunds, at Rs. 6 per maund.	30 0 0
Watering three times ...	15 12 0	3 15 0	0 9 0		
Canal charges	...	1 8 0	2 4 0	Arhar 2 maunds, at one maund per rupee.	2 0 0
Cost of nandha ...	...	0 1 6	...		
Ditto lope and beri ...	...	0 2 6	...	Castor-oil seed 20 seers, at 14 seers per rupee.	1 6 0
Weeding	2 12 0	2 12 0	2 12 0		
Cutting plant	1 9 0	1 9 0	1 9 0	Hemp 10 seers ...	1 0 0
Ditto seed	0 10 0	0 10 0	0 10 0	Arhar stalks and bhúsa ...	1 0 0
Separating seed pots ...	0 10 0	0 10 0	0 10 0	Indigo stalks 40 mds. ...	1 4 0
Threshing	1 13 0	1 13 0	1 13 0	Castor-oil trees 8 ...	0 8 0
Winnowing	0 5 0	0 5 0	0 5 0		
Rent	10 0 0	10 0 0	10 0 0		
Total cost ...	41 2 0	27 2 0	23 2 0		
Total produce ...	47 2 0	47 2 0	47 2 0		
Deduct total cost ...	41 2 0	27 2 0	23 2 0		
Balance profit ...	6 0 0	20 0 0	24 0 0	Total produce ...	47 2 0

(1) INDIGO.

"The price of plant varies from year to year, of seed it may be said from "day to day, being a purely speculative crop: Rs. 20 per "100 maunds plant, the carriage falling on the manufac- "turer, is a common but low rate, and given in advance chiefly; Rs. 25 to "Rs. 27 is got when the ryot carries for himself, or when he sells at his own "option as harvest (*khush kharíd.*). In one instance so great was the com- "petition between two rival factories for plant that Rs. 32 and even Rs. 40 "were given for 100 maunds.

Price.

"Seed sold in the year of the highest speculation as high as Rs. 42 per "maund, but Rs. 6 per maund is about the average price that the cultivator "gets.

"The seed is largely exported, Bengal manufacturers finding they obtain "the best plant with foreign seed. It is a pity this principle does not obtain "more in the North-West Provinces.

"The indigo plant is subject to no danger from insects. Cows and sheep "will not eat it, though they graze on the grass amongst it, "but buffaloes and goats eat it freely. It suffers quickly "from want of water in the hot winds.

Injuries.

"The area recorded under this crop in the measure- "ment papers is 24,083 acres (Cawnpore district).

Area.

"Before cutting indigo *púja* is performed by taking a male goat with "*ghí*, rice, sugar, or *dhúp* (incense) and water to a corner "of the field. The goat (whose head must not look "towards the south) is then worshipped with the other things and killed with a "chopper (*garasi*) if the owner eats flesh, if not, cut in the ear and let go, "when it becomes the property of *fakírs*; or a corner tree is worshipped "with *dhúp* and a few sweetmeats, which will afterwards be distributed to "friends."

General.

The plant is but seldom left as a second year's crop, since if cut in July or in August it generally dies out in the cold weather. Plant which has not been cut, but has been allowed to ripen, seed, and die down naturally, comes up again in the spring, and with early rain will yield a good crop of leaf. Plant which is cut in its first season is known as *jamowa*, while that allowed to seed and cut in the second year is known as *khunti*.

Second crop.

With regard to the price usually paid for the cut plant, it may be added that as a rule *khush kharíd* plant (or plant not sold till ready for manufacture) sells for Rs. 5 a 100 maunds more than *badni* plant (that which is contracted for when sown). In one year the

Price of plant.

difference in the prices was as much as Rs. 15, *khush kharíd* selling for Rs. 40 and *badni* for Rs. 25. The outturn per acre of plant irrigated by canal water is larger than that watered from wells; but in the opinion of planters in the Doáb consulted on this point this advantage is very much counter-balanced by the smaller quantity of dye yielded by canal plant, which in some cases is as much as 50 per cent. less than that given by well-irrigated plant. In consequence, the price of canal plant is less than that of well plant: if the latter is selling at Rs. 28 per 100 maunds, the former will often not fetch more than Rs. 16 or 17.

Comparison of plant irrigated from canals and from wells.

The indigo of commerce results from the atmospheric oxidisation of the *indican* dissolved in water, which forms a compound (called the "fecula") insoluble in water, alkalis, or acids. The process of extracting the dye from the leaves may be broadly considered as the extraction of the indican by continued soaking of the leaves in water, and its subsequent oxidisation by agitating the solution and so exposing it to the action of the air.

Mode of extracting the dye.

The plant is cut before flowering to within six inches of the ground and carried to the factory, where it is at once thrown into masonry vats and covered with water. Before commencing a description of the mode in which the dye is extracted, it must be mentioned that indigo cakes may be prepared either with or without boiling. For the European market, the sediment of colouring matter which is obtained from the leaves of the plant is invariably boiled, whence the cakes are known as *pakka* or *cooked;* but a great deal of the indigo consumed in the Indian market is the so-called *kacha* or *raw* kind—that is, prepared from the unboiled sediment.

The steeping.

Kacha and pakka cakes.

A factory in which indigo is manufactured, chiefly for export, consists of a double row of masonry vats, a furnace with boiler, and apparatus for straining the sediment and making it up into cakes. To prepare *kacha* indigo, all that is needed are some masonry vats, which are generally sunk in the ground.

The factory.

The time during which the plant should be steeped depends on the temperature, and this varying a great deal in different cases, is only known by experience. In close sultry weather, with an easterly wind and thermometer 96° in the shade, 11 or 12 hours are sufficient; if the air be dry, with a westerly wind, 15 or 16 hours are required. If the plant be ripe, less time is needed than if cut while immature. It is most important that it should be steeped for exactly the proper time, since on this, in a great measure, depends the quality and quantity of indigo produced.

Steeping.

(1) INDIGO.

Tests. The following are the chief signs of the plants having been sufficiently steeped :—

(i.) Bubbles, rising to the surface of the water, bursting at once and not remaining there.

(ii.) A sherry tint in the water covering the plants.

(iii.) A somewhat pungent odour from the water, which before had a raw, unpleasant smell.

Beating. When from these signs it appears that the plant has been steeped long enough, the water is let down into a second vat, and the process of *beating* commences. Seven or eight men stand in each vat and agitate the water either by hand or with a wooden paddle, increasing their efforts as the fecula begins to separate, which is known by the subsidence of froth and the change in the colour of the water from green to dark-blue. The time usually necessary for the beating is from $1\frac{3}{4}$ to 3 hours; no positive rule can be laid down.

Tests. The following are among the commonest modes of testing whether the indican has been sufficiently oxidised :—

(i.) A little of the water is allowed to stand in a saucer ; if the fecula subsides readily, leaving the water of an orange or sherry colour, the beating may be stopped.

(ii.) A coarse cloth is dipped into the vat : if the water which runs from it, when wrung, is of a greenish colour, the beating must be continued; if orange or brownish, it may be stopped.

(iii.) If the beating has been sufficiently prolonged, the surface of the water becomes of a peculiarly glossy appearance, and the froth subsides with a sparkle and hiss like champagne.

Precipitation of the dye. If ready, the water is allowed to stand in order to allow the fecula to subside. In former times this was generally hastened by the addition of some cold water or weak limewater, but as a rule nothing is used now in the European factories. After three or four hours, when the dye particles have subsided, the surface water is drawn off, and the fecula, which has a dark-blue muddy appearance, is carried to the boiler. It

Boiling. should then be brought to the boiling point as soon as possible, and kept there for five or six hours. Meanwhile it must be continually stirred, to prevent burning, and occasionally skimmed with a perforated ladle. It is sufficiently boiled when it assumes a glossy appearance;

Straining. it is then run off on to the straining table, where it remains for 12 or 15 hours, till most of the water has run off, after which it is gradually pressed for 12 hours in a screw press. It is then ready to be

Pressing. cut into cakes, stamped and laid in the storing-house to dry.

Good indigo cake should contain from 50 to 60 per cent. of indigotine (or oxidised indican); it should be bright, of a dark-blue colour, with a coppery gloss, breaking with an evenly coloured fracture; it should not part with its colour by light friction.

Yield of plant in indigo.

As a rule about 73 cwts. of plant are steeped in a vat 20 feet square and 3½ feet deep. It is considered a good outturn if this gives 25lbs. of indigo cake.

Preparation of kacha cakes.

The foregoing is an outline of the method followed at the factories in which indigo is prepared for the European market. Most of that for consumption in India is not boiled, but prepared in the so-called *kacha* form at numerous village manufactories, which consist merely of two or three masonry vats sunk in the ground, without the more expensive accessories of furnace and straining-room. The following account of the manufacture of *kacha* indigo cakes is taken from the district report of Muzaffarnagar :—

"As in the factories, the process commences by steeping the plant in water, which is allowed to continue for one night. The surface water is then drained off, and the soaked plants are trodden out by men for about six hours. Some dhák tree (*Butea frondosa*) gum is then added in the proportion of about 8 ounces per vat.

"Water is again run into the vat and the steeping continued for a few more hours, when the water, loaded with indigo particles, is drawn off into another vat, well beaten, and the fecula allowed to settle; when this has taken place the surface water is drained away and the muddy-looking residuum collected in earthen or metal pans, strained, and spread out on cloths resting on a layer of sand. In this way the remaining moisture is absorbed. The indigo is then moulded into cakes, each about the weight of 8 ounces, finally dried on ashes and in the sun, and after about a week is ready for the market. The imperfect manner in which the leaves and fibres of the plant are separated from the fecula, and the addition of foreign substances, like gum, to assist fermentation, result in the production of indigo very inferior to that made up in factories properly so called, however well suited to the moderate requirements of the dyers of the country. The vernacular name for the plant when first thrown into the vats is *lahda;* the fecula is known as *gádh*, a name sometimes attached to fully prepared indigo of the *kacha* sort; the indigo cakes are generally called *battis*."

For mere domestic use, when the dye is to be utilized as soon as extracted, the plant is simply steeped in a closed basin in water in which a little carbonate of soda or shell lime has been dissolved, and kept so for five or six days, till it begins to ferment, when it is ready for use.

(1) INDIGO.

Substances needed to assist precipitation.

Besides gum, the bark of the jáman (*Eugenia jambolanum*) or wild plum (*Zizyphus jujuba*) is sometimes thrown into the vat to aid in precipitating the fecula.

Cost and profits of cultivation.

The cost of cultivation will of course be the same, whether the indigo is made up in the *kacha* form or prepared for the European market; it has been shown above.

It is difficult to give any price as the average for indigo. Below are shown for three "marks" of the Aligarh district the highest price per maund, the lowest price, and the average for the 10 years between 1866-1876. It must be borne in mind that a maund of indigo costs in making about Rs. 125:—

	Highest price.	*Lowest price.*	*Average, 10 years.*
	Rs.	Rs.	Rs.
M. I. B. ...	238 (1871)	106 (1875)	180
W. M. F. F. ...	251	123	190
M. D. O. ...	211	108	176

If the cultivator sells the plant when cut, he gets on an average Rs. 26 per 100 maunds, if he has grown it with his own capital and can sell to whom he pleases (*khush kharid*); if he is bound by having accepted advances, he as a rule will not get more than Rs. 18. Taking the outturn per acre as 50 maunds of plant, his gross profits on the plant alone will be Rs 13 or Rs. 9, and he must look in great measure to other crops grown with it, or to a crop of seed from the sprouts sent up by the plants after reaping, to defray his expenses and give him the net profit he works for. It must be noticed, however, that in the account of expense and profit (quoted from Mr. Wright's Memorandum on Agriculture) the cultivator's own labour has been priced, and the figures are based on the assumption that the land is worked by a capitalist who employs nothing but hired labour.

Methods of using the dye.

The methods in which indigo dye is used in the manufactories of Europe does not concern the present report; on this subject it will be sufficient to give an account of the modes of dyeing practised by native dyers, by whom, as has been before noticed, the *kacha* indigo cakes are generally used.

The application of indigo dye to cloth depends on the fact that *indigotine*, though ordinarily insoluble in either water, acid, or alkali, is soluble in the latter when combined with hydrogen. It then forms what is called *white indigo*, in which state it is applied to the cloth. On being reoxidised by exposure to the air, it reassumes the blue tint and again becomes insoluble, except under the same conditions. The mode generally adopted is to mix indigo dye with an alkali in the presence of some agent which will, by attracting the oxygen of water, free its hydrogen. In England the agent thus employed is

frequently ferrous sulphate, which becomes ferric sulphate by attraction of oxygen from water ; in India it is generally brought about by fermentation.

Fermentation.

This fermentation is excited by the addition of certain alkaline substances together with some saccharine matter, and occasionally by raising the temperature. A pound of powdered indigo is soaked in a solution of 3lbs. of lime and 4lbs. of impure carbonate of soda in water. The carbonate of soda used is the alkali known as *reh*, which, by its efflorescence, has rendered so much of the land in these provinces uncultivable. About 4 ounces of sugar are added and the mixture is left to stand ; if fermentation does not commence in seven or eight hours, some lime and more sugar is thrown in and the mixture well stirred. If, still, it does not ferment within two or three days and the weather be cold, the vessel is placed over a fire and chemical change assisted in this way. The proportion of alkaline matter and sugar added to excite fermentation varies in almost every town. As a rule the amount added to 1lb. of indigo is between ¾lb. and 2¼lbs. of lime and 2lbs. and 2½lbs. of soda. At a town named Chibramau, in the Farukhabad district, a small quantity of a decoction is added, made from a plant called *bathua*, the stinking goose-foot (*Chenopodium album*).

Colours in the production of which indigo is used.

The colour yielded by indigo when applied to cloth by itself is a dull blue, depending for its depth on the number of times the cloth is dipped into the fermented infusion : thus, to produce the colour known as *asmáni* (*lit.* sky blue) the cloth is only dipped once, while to give it the dark-blue shade known as *nila* it is dipped and dried four or five times. As a rule the dyers of this country do not own the cloth they operate upon, which is sent them to be dyed the shade required. The manner in which the cloth is prepared for the application of the dye varies according to its description : it is noticed in Part II. of this report.

Mordants.

Mordants, in the proper sense of the word, are not needed, as the dye is fixed on the cloth by atmospheric action alone. Lime, carbonate of soda, and other alkalies, bark of the mango tree (*Mangifera Indica*), infusion of gall-nuts (*Quercus infectoria*), and acidulated water, are used to clear the colour.

The dye produced in the mode described above is fast, whether a mordant is used in the application or not ; were the indigo not fermented, the colour would be fleeting.

The colours in the production of indigo used in company with other dyes run from blue-black to light green. Whether the shade thus produced be fast or fleeting depends on the substances with which indigo is associated : if, for instance, this be turmeric, the colour will be fast ; if safflower, it will be more

(1) Indigo.

or less fleeting. In no case are the various dyes *mixed*. To produce what may be called a composite shade, such as *purple*, the cloth is first dyed in one, and then in the other of its component colours. Beneath are given, in order from blue-black to green, the chief shades in the production of which indigo bears a principal part; the different dyes are mentioned in the order according to which they are used. The word *cost* indicates the expense incurred by the dyer, and the word *charge* the price he takes for dyeing a piece of cloth $2\frac{1}{2}$ yards by $1\frac{1}{2}$:—

Blues.

Colours produced.

Black Blues (*Ver. Kála* of Cawnpore)—
(1) Infusion of myrobalan (*Terminalia chebula*).
(2) Sulphate of iron (*Ver. Kasis*).
(3) Indigo.
Colour fast, *cost* 2 annas, *charge* 8 annas.

Dark Blue (*Ver. Nila* of Farukhabad)—
(1) Indigo (dipped four times).
Colour fast.

Light Blue (*Ver. Asmáni* of Farukhabad).
(1) Indigo (dipped once).
(2) Alum water.

Red Blues (Purples).

Purple (*Ver. Sansni* of Benares)—
(1) Indigo.
(2) Sappan wood,
or (2) Safflower.
Colour partly fast.

Purple (*Ver. Surmai* of Allahabad)—
(1) Indigo (twice dipped).
(2) Safflower.
(3) Indigo (three times dipped).
Colour fast.

Lavender (*Ver. Kohai* of Farukhabad)—
(1) Safflower.
(2) Acidulated water.
(3) Indigo.
Colour partly fast.

Mauve (*Ver Bádsháhpasand* of Allahabad)—
(1) Safflower.
(2) Indigo.
Colour fleeting, *cost* 1 anna, *charge* 3 annas.

Lilac (*Ver. Phalsái* of Benares)—
(1) Safflower.
(2) Indigo.
Cost $1\frac{1}{2}$ anna, *charge* 3 annas.

Yellow Blues (Greens).

Dark-blue green (*Ver. Sábz Káhi* of Etah)—
(1) Indigo.
(2) Turmeric.
(3) Infusion of myrobalan.
(4) Indigo.
Colour fast, *cost* 1 anna, *charge* 2 annas.

Sap green (*Ver. Káhi* of Aligarh)—
(1) Turmeric.
(2) Indigo.
(3) Infusion of pomegranate rind.
Colour fleeting.

Yellow green (*Ver. Pistai* of Allahabad)—
(1) Turmeric.
(2) Indigo.
(3) Alum water.
Colour fast, *cost* $1\frac{1}{2}$ anna, *charge* 4 annas.

Only a few of the best known shades have been mentioned as examples. The relative quantities of the various substances used are not specified, since it is impossible to calculate the amounts consumed in dyeing the piece of cloth that has been taken as the standard on which to reckon the cost and profits of the dyer. It will be seen that the profits are on the average 2 annas.

It is noticeable that it is the dye first applied which gives the prevailing tint to the colour: thus, to produce dark-blue green indigo is applied before the yellow dye turmeric, while for yellowish green the turmeric is applied first.

(1) INDIGO.

Every colour is not fast in the production of which indigo enters: if the dye with which indigo is combined is fast, the product will also be fast; but if, like safflower, the second dye is fleeting, the permanence of the compound colour depends on the amount of indigo used and the order in which the two dyes are applied to the cloth: if the indigo is applied first, the compound will as a rule be *fast* to some extent, while it may be altogether *fleeting* if the first dye applied be the fleeting one.

Average area under cultivation.
Average amount anually exported.

The statistics which have been sent in from the different districts of the average area under cultivation are shown in appendix I. The area is under the mark since indigo is frequently grown with other produce as a subordinate crop, and thus escapes record. Statistics of the proportion annually exported cannot be accurately ascertained, but three statements are given in appendix I. showing the amount of North-West Provinces produce consigned to Calcutta. All indigo cake manufactured in the factories is exported to Calcutta. Places at which there is a considerable dyeing industry, such as Mau Ránipur in Jhánsi, take a good deal of the better sort of *kacha* cake, and the portion locally consumed is as a rule almost confined to the inferior qualities of this latter. The chief indigo-producing districts in these provinces are Aligarh, Bulandshahr, Etah, Cawnpore, and Gorakhpur.

The manufacture in these provinces is certainly declining so far as European capital is concerned: from nearly every district there come accounts of factories closed and concerns sold up for nominal prices. But in many cases these must be taken to indicate not the decline of the manufacture itself so much as the increasing inability of European planters to compete with native *zamindárs*. If the planter himself is a landholder he has far more chance of success; but as a capitalist or manufacturer he can only tempt the cultivators with high prices to bring their indigo to his factory, while the landholder can bring to bear on them the fear of ejectment. The "planter" has no means of recovering his advances or compensation for breach of faith, except through the law courts; the *zamindár* can put a thousand pressures on a defaulting cultivator and compel payment by fear of social as well as legal penalties.*

(2) SAFFLOWER.

(2) Safflower (Ver. Kar, Kusum.) A crimson dye obtained from the flower of *Carthamus tinctorius; Nat. Ord. Asteraceæ.*

Description.—Annual, 1-2 feet; stem erect, cylindrical, branching near the summit; leaves oval, sessile, much acuminated, somewhat spiny; heads of flowers enclosed in a roundish spiny involucre; flowers large, deep orange (Drury.)

* For further particulars of indigo regarding area, outturn, exports, size of vats, &c., see appendix I.

(2) SAFFLOWER.

Safflower is more or less cultivated in most of the districts in these provinces, generally as a subordinate crop, but occasionally by itself.

Mode of cultivation.

By subordinate *crop* is meant a crop grown in company with the main crop, to which the cultivator chiefly looks for his profit. In these provinces such mixtures are almost universal, and it is often difficult to find a cotton-field in which some arhar (*Cytisus cajan*) has not been sown, or a wheat-field which is not bordered with rape (*Brassica rapa*) or mustard (*Brassica juncea*). Such secondary crops are sometimes sown broadcast, as is the case with gram (*Cicer arietinum*) commonly sown with barley, and sometimes in regular lines, like arhar in cotton or the rape in wheat. *Safflower* is grown as a secondary crop in company with barley, gram, or carrots. It is generally sown in lines, and in some districts scarcely a carrot-field can be found which is not bordered in February with its bright orange flowers. It is often sown with carrots in cotton-fields which have yielded their first November crop. Since it is comparatively seldom sown alone an account of the cultivation of carrots, gram, or barley or other crops with which it is mixed would be necessary for a fair explanation of the method of treating a field in which it is grown. The seed is sown at the close of the monsoon on well-ploughed land. When sown alone, the quantity of seed is said to be 24lbs. to the acre. The plants begin to flower in February when about 2½ feet high; from then till May the flowers are picked off each day as they appear, leaving the flower-heads on the stalk. All that is detached is the fragile-looking *corolla* which issues from the summit of the prickly teazle-like flower-head. When these are picked off, their subsequent treatment depends on whether they are to be made up into the safflower of commerce, or whether they are merely to be prepared for dyeing purposes in this country.

Sowing.

Picking.

If the former is intended, the florets are damped with water and pressed into lumps. A rough strainer is made by stretching a mat on a wooden frame; on this the lumps of florets are laid and water is slowly poured over them, while a man treads them out with his feet, supporting himself on two sticks used as crutches. In this way the yellow colouring is eliminated from the flowers, the presence of which would detract from the beauty of the crimson tint for which they are chiefly prized. When the water (which at first is coloured yellow) comes clear through the strainer, the process is complete. The flowers are then made up by hand into round flat cakes, the water squeezed off, and they are dried in the sun. In this form they are known as the safflower of commerce.

Subsequent preparation for—
(*a*) Safflower of commerce.

Safflower intended for use in this country is not washed in the method above described at the time they are picked. The flowers are simply dried, in which state they are sold by cultivators.

(*b*). Safflower for country use.

There are thus two pigment principles in safflower—safflower yellow, which is extracted by pounding and washing, and safflower red (or carthamin), which is the dye of commerce. The carthamin is a resinoid subtsance, giving to cloth a beautiful crimson colour, which, however, oxidises yellow in light. It is one of the chief ingredients in *rouge*. It is soluble in an alkali, which is used to extract it from the cakes of florets; an acid precipitates it. The crimson dye attaches to cloth without need of a mineral mordant.

Method of dyeing.

The methods in which safflower is used for dyeing purposes in Europe are not concerned in this report; the mode in which the dye is applied in these provinces is described below (the dye used consisting merely of the dried florets as sold by cultivators).

The flowers are powdered fine and sifted. The powder is sprinkled with water or oil, and, after having been kept in this state for some time, is rubbed with the hands (much in the same way as the fresh flowers are when the safflower of commerce is to be prepared from them), and the yellow colouring matter is eliminated by straining in exactly the same manner. This yellow dye (or *piyan*) is as a rule considered useless; occasionally it is used in dyeing scarlet or crimson as a base on which the more valuable red dye is applied. When the yellow colouring has been completely washed out, an alkali is mixed with the powdered flowers. This, when obtainable, is generally the ash of the bájra (*Penicillaria spicata*) or the *chirchira* (*Achyranthes aspera*), which contains a considerable amount of potash. When this cannot be obtained, the alkaline earth known as *sajji* is mixed with the powder in the proportion of 8 drachms to a pound of the latter. The alkali is well mixed with the flower powder and rubbed into it with the hand. The paste is again placed on the strainer, and when water is poured over it, it drops through, not this time of a yellow, but of a deep-red colour. As a rule a quart of water is strained through a pound of safflower, and the tincture that results is then ready for dyeing purposes.

But besides the first and the best tincture two others are obtained by straining more water through the safflower; both times a quart of water is used for the pound of safflower, and each tincture is lighter and less valuable than the one which preceded it. It is usual to add some more alkali before straining for the third time.

The cloth is dyed by being dipped into the tincture, the depth of the shade produced depending on the number of times it is dipped and dried. Acidulated water is often added to the dye when used, but the colour produced is fleeting.

Colours produced by safflower.

The principal shades of colour in the production of which safflower takes a chief part are noted below. The purples (or red blues) which are produced by combination of indigo and safflower

(7) SAFFLOWER.

have been noticed in the account of the former dye. The other shades for which *kusum* is used run from scarlet through pink and orange to yellow:—

SCARLET (*Ver. Surkh* of Tirwa in Farukhabad)—

(1) Yellow safflower water.
(2) Red safflower tincture of 3rd straining.
(3) Ditto ditto 2nd ditto.
(4) Ditto ditto 1st ditto.

Colour fleeting, *charge* (for dyeing a piece of cloth 2½ yards × 1¼ yard) 4 annas.

RED (*Ver. Gulanár* of Farukhabad)—

(1) Red safflower tincture of 3rd straining.
(2) Ditto ditto 2nd ditto.
(3) Ditto ditto 1st ditto.
(4) Turmeric.

Colour fleeting *cost* 6 annas, *charge* 8 annas.

MAGENTA (*Ver. Gulabbási* of Agra). Same process as in *red*, only substituting indigo for turmeric.

PINK (*Ver. Sappai* of Cawnpore)—

(1) Safflower (weak tincture).
(2) Harsinghár.
(3) Acidulated water.

Colour fleeting, *charge* to 4 annas.

ORANGE (*Ver. Nárangi* of Etáwah)—

(1) Safflower (strong tincture), ½lb.
(2) Harsinghár, 4 oz.
(3) Acidulated water.

This is *blood* orange. *Yellow* orange or *zafráni* is produced if the harsinghár is applied before the safflower.

Colour fleeting, *cost* 1½ anna, *charge* 4 annas.

YELLOW (*Ver. Badámi* of Farukhabad)—

(1) Safflower, ½oz.
(2) Harsinghár, ½oz.
(3) Acidulated water.

Colour fleeting, *cost* one pice, *charge* 1½ anna.

Other shades of yellow, such as the *sharbati* of Allahabad, are produced by varying the proportions of safflower and harsinghár.

Statistics of cost and profits of cultivation.

From safflower being so seldom cultivated by itself or as the principal crop of a field, any attempt to estimate the profits and loss of its cultivation must, as explained, be somewhat hopeless. When sown alone the amount of seed used is 24lbs. per acre, costing about 14 annas. This may be expected to yield about 32lbs. of the safflower of commerce, worth some six or seven rupees. When sown amongst carrots, or with the mixture of barley and gram known as *bejhar*, the amount of seed used varies with every field. Since the flowers are generally picked by the women and children of the cultivator's family, no expense can be charged on this head; while, if sown as a secondary crop, the

cost of ploughing, watering, &c., is of course merged in that of the principal one. The seeds of the plant contain an oil which is used for lighting purposes. They also make excellent fodder in the shape of oilcake, and indeed the whole plant when chopped up is readily eaten by cattle in spite of its prickly appearance. (2) SAFFLOWER.

Area of cultivation.

The statistics as to the average area of cultivation and average weight of annual produce must always be unsatisfactory. Returns on the former point are most deceptive, since they include all fields on which even the smallest quantity of safflower was sown; and figures relating to the second point are necessarily unreliable, being the result of conjecture only.

Most of the amount produced is locally consumed or sent to large dyeing centres, such as Farukhabad, Cawnpore, Agra, and Háthras.

Market value.

The price of the safflower of commerce is about 3 annas per pound, of the dried flowers about 1½ anna.

(3) Ál. (No English name). A red dye obtained from the roots of *Morinda citrifolia ; Nat. Ord. Cinchonaceæ.* (3) AL.

Description.—Small tree; leaves opposite, oval, alternated at both ends, shining; capitull shortly peduncled, leaf opposed; branches 4-angled, corolla long-infundibuliform, 5 (occasionally 4-7) cleft; anthers half hid in the tube; berries concrete into an obtuse ovate shining fruit; flowers white (Drury.)

Mode of cultivation.

The cultivation of *ál* is chiefly confined to the Bandelkhand districts of these provinces (Bánda, Hamírpur, Jhánsi, and Jalaun), although it is also grown in the southern parts of the Fatehpur and Cawnpore districts bordering on the Jumna. It does best on the peculiar black soil of Bundelkhand. The following description of its mode of cultivation is taken from Mr. Wright's Agricultural Memorandum quoted before :—

Statistics per acre.

Ploughing.	Time of sowing.	Seed.	Weeding.	Cutting.	Digging.	Chopping.	*Outturn.* Root.
5	Sáwan (July).	2 mds.	8 times; ploughed twice.	20 men a day.	10 men a month.	4 men a day.	10 mds.

Varieties. None.

Preparation of ground.

"*Ál* is grown in black (már) soil because it is friable. Land designed "for *ál* is sown with spring crop for two or three years, but "is not manured.

Ploughing.

"On the first fall of rain the land is ploughed with the "*bakhar* plough not less than five times, oftener if possible.

(8) AL.

Sowing.

"Towards the end of July the seed is sown broadcast
"and thoroughly mixed in the ground with the *bakhar*.

"Early rain after sowing is necessary, after which the plant sprouts in some
"20 days. It is weeded four times, and has to be protected from being injured
"by cattle, which, though they do not eat it, trample down the young plants.
"In the second year's rain it is about two feet high and is weeded twice. In
"the third year's rain the field is ploughed, to allow the rain to reach the roots
"of the plants, and the same the fourth rains.

Cutting.

"About the end of December the trees are cut down (about 20 men will cut an acre in a day) and the roots are dug up with pickaxes: this will take ten men a month, as the ground has
"to be dug carefully and to the depth of two feet. When brought home, four
"men will chop it up into lengths, eight men sorting into different classes. Each
"root is divided into three, according to thickness. It is then dried and packed
"close in gunny bags. The seed is collected in the third year; the kernel is
"separated from the shell by the seed being kept watered till the shell rots
"when the kernel is stamped out with the feet or a hoe.

Outturn.

"An acre will produce about 10 maunds root, one-third
"being of each class; 6 maunds seed is also obtained.

Price.

"The price has fallen so greatly of late years that it can hardly be grown
"except at a loss. It is a pure speculation. The thin end
"of the root is the best, and fetches now Rs. 8 per maund;
"next, the middle portion, which fetches Rs. 4 per maund; and last, the thick
"end, the least valuable, worth Rs. 2 per maund.

Uses.

"From the root is extracted a red dye, being the
"dark red, which is the colour seen in *khárua* and other native cloths.

Cost of production.

"According to the estimate given, this crop can now
"only be produced at a loss, as follows:—

	Rs.	a.	p.
Seed	6	0	0
Weeding	9	8	0
Cutting	1	4	0
Digging	37	8	0
Sorting	1	0	0
Bags	2	0	0
Watching	16	0	0
Rent	16	0	0
Total cost ...	89	4	0

Exclusive of ploughing.

"At above rates the produce comes to Rs. 46.

Area. "The area (in Cawnpore) recorded under this crop "in the measurement papers is 137 acres.

"It is a superstition that whoever digs up the roots of the *ál* destroys or "extirpates his *ál áulád* or family: hence but few grow it,

General. "and generally of the *baniya* class—only those in fact who "are known to be 'lucky.'

"The different classes of root are called as follows:—

1st class—thin, *hárgharka* (*bhára* Jalaun, *bár* Jhánsi).
2nd „ —middle, *lari* (*jharan* Jalaun, *pachmer* Jhánsi).
3rd „ —thick, *pachhkat* (*ghatiya* Jalaun, *lari* Jhánsi).

"*Bhára* are the thin threadlike roots on the principal top roots, collected "and packed with 1st class. Very thick roots are called *katerão;* they are "almost worthless, but are peeled and mixed with *hárgharka* by way of "adulteration."

The *bakhar* is the "*hoe plough*" used in Bundelkhand districts in place of the ordinary short conical share; it has a kind of hoe about 20 inches broad and 5 deep. This enters about 8 inches into the ground, and, though not *turning* the soil *over* any more than the ordinary plough does, is still a far more powerful instrument for breaking up the earth and eradicating weeds.

It will be seen that, according to Mr. Wright's account, *ál* can now be only cultivated at a loss in the Cawnpore district. In Bundelkhand, where the quality of the soil is more favourable, as much as 10 cwt. of roots is produced per acre. The 10 maunds given by Mr. Wright are equal to 7 cwt. 36lbs.

It will be noticed that *ál* takes 3½ years to come to maturity. A high price

Different qualities. is necessary to recompense the cultivator, and the value of *ál* seems steadily on the decline. The thinnest part of the roots (*bhára*) used to sell at Rs. 20 the maund (of 82lbs.), it now only fetches Rs. 8; the middle part of the roots (*jharan*) sells at Rs. 4 instead of Rs. 10; the upper and thickest part at Rs. 2 instead of Rs. 9.

After digging up the roots the cultivators do nothing more than to cut them in pieces and sort them according to the three qualities. They are sent in this state to market.

In *ál* dyeing the previous preparation of the cloth is the most noticeable

Method of dyeing. thing. The colouring matter is, as with safflower, not extracted from the plant till in the actual operation of dyeing. The roots are mixed with a little sweet-oil and ground to powder in a hand-mill. Cloth is dyed by being as a rule boiled with this powder. The kind of cloth most frequently dyed with *ál* is the coarse fabric known as *kháruа*. The following is a description of the process of dyeing which is for the most part applicable to every other kind of cotton cloth:—

(3) Ál.

Preparation of the cloth to receive the dye.

The cloth is well washed and soaked in water with which some powdered sheep's dung has been mixed; the next step is the bleaching (ver. *merái*). For this a mixture is made of 4lbs. of castor-oil, 5lbs. of the alkaline earth known as *rassi*, and 1¼lb. of sheep's dung in about 30 gallons of water. The cloth is steeped in this mixture for 12 days, when it is washed in clear water. It is then soaked in a decoction of myrobalan (*Terminalia chebula*) in water, and after that in alum water. It is then ready for the application of the dye. For each piece of cloth measuring 8 yards × 1 yard 30lbs. of powdered *ál* are mixed with water and boiled. Into the mixture, while boiling, the cloth is thrown and boiled with it till it has become dyed to the shade required. It is then cleaned and washed. It is sized by being dipped in a solution of gum and water and beaten smooth with wooden clubs.

The term *khárua* is properly applied to this cloth when it has been dyed a dull-red colour in this manner; before dyeing it is generally known as *ikri*. The manufacture and dyeing of this cloth is almost peculiar to the neighbourhood of Mau Ránipur, in the Jhánsi district, and the following mention of it is made in the settlement report of that district :—"The town of Mau Ránipur is chiefly peopled by *dhobis* (washermen) and *chipis* (the caste who dye in *ál*), besides the *baniyas* who are engaged in the *khárua* trade, which is an important branch of industry and one of great consequence to the prosperity of the place." The following is the cost of dyeing a bale of 60 pieces of the cloth :—

	Rs.	a.	p.
20 lbs. of sheep or goat's dung	0	0	3
4 gallons of castor-oil	3	8	0
3 „ of *rassi*	0	8	0
6 lbs. of myrobalan	0	4	0
3 „ of alum	0	7	0
6 „ of *dha* flower	0	3	0
98 „ of *ál*, best quality	12	0	0
86 „ of *ál*, inferior quality	6	0	0
4 „ of soap	1	0	0
20 „ of gum	1	0	0
Washing	1	0	0
Firewood	1	0	0
Pay of beaters (*ver. kundigars*)	1	0	0
Total ...	27	14	3

A bale of undyed *ikri* sells for Rs. 56; after dyeing it fetches Rs. 90, giving thus to the dyer a profit of Rs. 6-1-9. The annual value of the export trade from Mau Ránipur in *khárua* and other cotton cloths and *ál* dye is Rs. 6,80,000.

The *dha* flower mentioned above is the flower of *Grislea tomentosa*; it is occasionally used with the *ál* as a purifier.

(3) Ál.

The well-known red *sálu*, much used for turbans, curtains, &c., is also dyed red with *ál*. In Cawnpore the cloth is of English make and of the quality called *markin*. It may be either steeped in tincture of *ál* or may be boiled in it. In the former case the colour is fleeting, in the latter permanent. The cloth is prepared in much the same manner as the *khárua* of Mau Ránipur.

The colour produced by *ál* is a dull red, not so brilliant, but far more serviceable than the safflower dye. It is but little used in the production of compound colours or intermediate shades.

The industry in which *ál* is chiefly used is that of calico-printing, which is separately noticed in Part II. of this report.

Cost and profits of cultivation.

Area of cultivation.

The *cost* and *profits* of cultivation are noticed in the account of its cultivation. The area on which *ál* is cultivated in the Jhánsi district is 1,450 acres. For other districts the area of cultivation is not known.

Average annual outturn.

The only way in which the annual outturn can be even approximately ascertained is by multiplying the number of acres by $\frac{1}{4}^{0}$, since the crop takes $3\frac{1}{2}$ years to come to maturity.

The consumption of the dye is certainly local, and it is believed to have never found its way to Europe. The principal marts at which dyeing in *ál* is practised in these provinces are Mau Ránipur and Háthras.

In 1876-77, 13,670 maunds of *ál*, valued at Rs. 2,66,226, were imported into the city of Cawnpore from the Bundelkhand districts.

(4) Madder.

(4) Madder (Ver. Manjhit). A red dye obtained from roots of *Rubia cordifolia; Nat. Ord. Cinchonaceæ.*

Description.—Herbaceous; stem rough, with prickles on the angles, rarely smooth; leaves in fours, long-petioled, oblong or ovate, acute; more or less cordate, 3-7 nerved, margins, middle nerve, and petioles rough with minute prickles; calyx tube ovate-globose; panicles in the upper axils peduncled, trichotomous, bracts opposite, not forming an involucre; flowers usually 5-cleft, whitish; berries red or black (Drury).

This plant is distinct from the European madder (*Rubia tinctorium*). Its chief habitat is the hilly tract of Assam and Kachár in Eastern Bengal, and the only region in which it is found in these provinces is the Himálayan range. The extent of its production is not known, but from 1869 to 1872 the annual exports from the Kumaun division only averaged 574lbs.

There are two other species of madder found growing wild in the Central Provinces; the roots of both being used in dyeing to a greater or less extent. One is a creeper occurring near the sources of the Nerbudda, the roots of which are dug up by the Gonds between November 1st and the end of May, and sold to the travelling merchants known as *Banjaras*, or exchanged for equal weights of salt. The other is a large forest tree.

(4) MADDER.

The colour of manjít is brighter, though not so durable as that of the European madder. No attempt appears to have been made to introduce the cultivation of this latter into India.

Like madder, the utility of manjít results from the presence of two colouring principles called alizarine and purpurine. These will not attach to cotton fabric unless in combination with a metallic oxide. This latter is called a mordant, the ones most generally used in England being alumina for shades of red and ferric oxide for purple. The mordant itself is dissolved generally in acetic acid, and is then combined with the colouring principle. The acetic acid is subsequently evaporated off. Or the metallic oxides may be applied in the form of soluble salts, such as aluminate of potash, &c.

In India the mordants used are alum and the red earth called *geru*, which is an impure oxide of iron. The alkalies which are used serve to brighten the colour, while a preliminary washing of the cloth in tannic astringents is found useful.

It may be noticed here that the dyeing principles in *ál* are of the same character as those in manjit, and the mordants used to fix them are the same in both cases.

Manjít is too expensive a dye to be much used ; dyeing with it is almost confined to the towns of Farukhabad and Bareilly. The roots are mixed with a little sweet-oil and powdered; afterwards ground in a hand-mill and strained with water. The cloth to be dyed is boiled with the powder until of the shade required, the colour being fixed by alum. Occasionally cloth seems to be dyed by being steeped in a cold infusion of the powdered roots in water. The following are the three chief shades of colour in the production of which it is generally used :—

Shades of colour produced.

SCARLET (*Ver. Surkh*)—	COFFEE BROWN (*Ver. Konchki*)—	MAUVE (*Ver. Kokai*)—
(1) Myrobalan, 2 oz.	(1) Myrobalan,	(1) Manjít.
(2) Alum, 1 oz.	(2) Alum.	(2) Indigo.
(3) Manjit (boiled for an hour), 6 oz.	(3) Manjít,	*Colour* fast, *cost* 1 anna, *charge* 3 annas.
(4) Washed and dried.	(4) Sulphate of iron.	
Colour fast.	*Colour* fast, *cost* 2 to 2½ annas, *charge* 3 to 4 annas.	

Manjít is also used in calico-printing.

(5) TURMERIC.

(5) Turmeric (Ver. Haldi). A yellow dye obtained from the roots of *Curcuma longa; Nat. Ord. Zingiberaceæ.*

Description.—Leaves broad, lanceolate, long-petioled ; bulbs small, and with the palmate tubers inwardly of a deep orange colour ; flowers large, whitish, with a faint tinge of yellow, the tuft greenish white (Drury.)

This plant is largely grown in many districts of these provinces, but more as a spice used in native cooking than for use as a dye. Native cultivators

distinguish several varieties ; of the two commonest, the root of one when cut has a rich unctuous appearance, and this is the one which is used for dyeing purposes ; the other has a harder and drier root, and is only used as a spice in cooking vegetables and meat.

Mode of cultivation.

Turmeric is discoloured by the action of alkalies, and is therefore not considered a good dye. It is very seldom grown alone, and is generally planted in company with the yam (*Colocasia antiquorum*). The following description of the mode of its cultivation taken from Roxburgh applies to these provinces :—" The ground must be rich, friable, and lie so high as not to be overflowed during the rainy season. It is often planted on land where sugarcane grew the preceding year, and is considered an ameliorating crop. The soil must be well ploughed and cleared of weeds, etc. It is then raised, according as the rains begin to fall, into ridges 9 or 10 inches high and 18 or 20 broad. The cuttings or sets, *viz.*, small portions of the fresh root, are planted on the top of the ridges at about 18 inches or two feet asunder. One acre requires about 900 such sets, and yields in December and January about 2,000lbs. weight of fresh root." According to an account of its cultivation in the Cawnpore district, " it requires very plentiful irrigation, and is grown on *dúmat* (sandy loam) soil commonly in company with *ghuyan* (yam, *Colocasia antiquorum*). In June the ground is well manured, 40 cartloads being thrown on to one acre of land. It is then watered twice and well ploughed. When the rains set in the small roots of turmeric, to the amount of 250lbs. to the acre, are then planted, one to the square foot, and so much water do they require that trenches have to be dug through the whole field only one foot apart. After the rains it has to be watered every week. The roots are ready for being dug up in January."

Preparation of the dye.

When dug up the roots are boiled and dried in the sun : in this form they are the turmeric sold in the Indian bazars. When the dye is to be used, the roots are again boiled and powdered while wet. A decoction is then made of this paste in water, in which the cloth is well steeped, being subsequently dried in the shade. In the Kumaun district the roots are soaked in limejuice and borax before being powdered instead of being boiled. The manner in which turmeric is used in calico-printing is noticed in Part II. of this report.

The dye given by turmeric is of a dull yellow colour ; it is fleeting, and, except in dyeing the commoner sort of cloth, is seldom used, except in combination. The action of an alkali changes its colour to red.

Colours produced.

The shades of colour produced by turmeric in combination with indigo or safflower have been noticed under the heading of those dyes :—

(5) TURMERIC.

YELLOWS.

LIGHT YELLOW (*Ver. Zard* of Aligarh)—

(1) Turmeric, 2 oz.

(2) Alum 1 oz.

This is fleeting, but is fast when dipped in a decoction of pomegranate rind and again washed in alum water.

ORANGE (*Ver. Zard Chameli* of Benares)—

(1) Turmeric.

(2) Safflower.

(3) Turmeric.

(4) Limejuice.

Colour fleeting.

GREEN.

LIGHT GRASS GREEN (*Ver. Mâshi* of Cawnpore)—

(1) Myrobalan, 2 oz.

(2) Sulphate of iron, 2 oz.

(3) Turmeric, 2 oz.

(4) Pomegranate rind, 2 oz.

(5) Alum, 2 oz.

Colour fast.

BROWNS.

LIGHT BROWN (*Ver. Kishmishi* of Allahabad)—

(1) Myrobalan.

(2) Turmeric.

(3) Alum.

(4) Gallnuts.

(5) Safflower.

Cost 1½ anna, *charge* 3 to 4 annas.

DARK BROWN (*Ver. Telia Mâshi* of Aligarh)—

(1) Myrobalan.

(2) Sulphate of iron.

(3) Turmeric.

(Cloth washed in clear water.)

(4) Pomegranate rind.

(5) Alum.

Colour fast.

Cost and profits of cultivation.

The *cost* and *profits* of cultivation are given as below for the Cawnpore district :—

Cost (per bigha = ⅓th acre).

	Rs.	a.	p.
Rent	3	0	0
Six ploughings	2	4	0
Trenching	5	4	0
Canal water-rate	0	15	0
Labour in watering 15 times, at 4½ annas	4	8	0
Manure	2	8	0
Digging up the roots, 6 men for one day, at 1½ anna each ...	0	9	0
Total cost ...	19	0	0

The canal water is assumed to be let in at a lower level than that of the field. Four men for one day are needed to throw enough water up in baskets to irrigate a bígha; the fifth is employed in directing the stream of water in the field.

A bígha will yield 4 maunds (2$\frac{1}{14}$cwt.) of dried roots, which, selling at the rate of Rs. 9 per maund, will give a total return of Rs. 36. Deducting cost, Rs. 17 remain as profit, which is unusually large. This may be partly explained by the fact that land on which turmeric is grown becomes unfit for any other crop.

Area of cultivation.

No satisfactory statistics have been collected concerning the area on which it is grown or the total annual produce. Had they been obtainable they would have been of but little value for the purposes of this report, since it must always be impossible to estimate with any approach to accuracy the proportion of produce consumed as a spice. The amount of dye actually produced (depending as it does on the *intention* of the cultivator) would always be unascertainable.

I. A. (2) *Vegetable dye substances produced in the North-West Provinces, derived from trees or plants of spontaneous growth (including animal deposits on trees).*

There are twenty-one vegetable substances used in dyeing, produced from trees or plants either self-grown in these provinces, or cultivated for the sale of some product other than the dye they yield. Only thirteen of these can be styled articles of commerce: the remainder have no market value, and their use is restricted to places in which they can be obtained without cost.

These twenty-one substances may be classified into (*a*) colouring matters, and (*b*) mere auxiliaries in dyeing. Their names are given below :—

(*a*) COLOURING MATTERS.

(*i*) *Derived from animal deposits.*
Lac dye.

(*ii*) *Extracted from flowers.*
Harsinghár (Nyctanthes arbortristis).
Dhák (Butea frondosa).
Tún (Cedrela toona).
Genda (Tagetes patula).

(*iii*) *Extracted from leaves.*
Arusa (Adhatoda vasica).
Henna (Lawsonia alba).
Indrajau (Wrightia tinctoria).

(*iv*) *Extracted from fruit rind.*
Babul (Acacia Arabica).
Kamila (Mallotus Philippinensis).

(*v*) *Extracted from stem, root, or bark.*
Katha (Acacia catechu).
Darhaldi (Berberis tinctoria).
Lodh (Symplocos racemosa).

(*b*) DYEING AUXILIARIES.

(*i*) *Extracted from fruit rind.*
Naspal (Punica granatum).
Myrobalan (Terminalia chebula).
Oak-galls (Quercus infectoria).
Aonla (Emblica officinalis).
Bael (Ægle marmelos).

(*ii*) *Extracted from flowers.*
Dha (Grislea tomentosa).

(*iii*) *Extracted from leaves.*
Tejpat (Laurus cinnamomum).

(*iv*) *Acids.*

An account will be given of each of these substances in the order in which they have been mentioned above.

(*a*) *Colouring matters.*

(1) LACDYE.

(1) Lacdye* (Ver. Lakh).—A red dye obtained from the bodies of the insects by which *lac* is formed. The *dye* must be carefully distinguished from the *lac*, which is a semi-transparent deposit occurring on the branches and twigs of many Indian trees, amongst which may be mentioned the dhák (*Butea frondosa*), the coral tree (*Erythrina Indica*), and the pípal (*Ficus religiosa*).

This deposit is caused by an insect (*Coccus lacca*) somewhat similar to the cochineal; and has the appearance of an incrustation on the branches and twigs, often enclosing them in a sort of tube.

Lac is known by different names in the different stages of its preparation for the market. *Stick-lac* is the name given to the incrustations when first removed from the tree and adhering to the broken sticks and twigs removed with them. These when pounded, cleaned, and washed are called *seed-lac*, which becomes *lump-lac* by being melted up into masses. *Shellac* is *lump-lac* purified by being remelted and pressed through bags of fine linen. The incrustations are formed by the females of the lac insect when about to lay their eggs. A pellucid and glutinous substance exudes from the margins of the body, and in the end covers the whole insect with a cell, which when hardened by exposure to the air becomes lac. So numerous are these insects and so closely crowded together that they often entirely cover a branch: and the groups take different shapes as squares, hexagons, &c., according to the space left round the insect when first it began to form its cell. Under these cells eggs are deposited, which after a certain period are hatched, the young ones eating their way out (Balfour).

Preparation of the dye.

Lac dye is made from the watery infusion which remains after the trituration and washing of the stick-lac. This is evaporated to dryness and the residuum made into cakes about 2 inches square and half an inch thick.

Until a comparatively late date Mirzapur was the centre of lac manufacturing. "The location of the trade is now quite reversed. Mirzapur is no longer the head centre of the shellac trade, and Calcutta now justly claims title to that position, possessing as she now does a factory (Káshipur) and machinery capable of turning out more than sufficient shellac for the consumption of the entire world, *i.e.*, 5,000 chests per month" (*Trade Circular of Messrs. Toulmin and Co.*)

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* *Note.*—For full particulars about lac see pamphlet entitled "Lac," by J. E. O'Conor: Government Press, Calcutta, 1876.

(1) LACDYE.

The dye is employed in England for dyeing cloth scarlet, and the colour it gives is almost as bright as that produced by cochineal and much less easily affected by perspiration.

In these provinces lac dye is chiefly used in dyeing leather, silk, and wool.

Uses of lac dye.

The process followed will be described under the headings allotted to these industries. The dye is prepared for use by being boiled in water: in some places it is merely soaked in water with a little borax. The colours it produces are red, dark brown, and red brown.

From some statistics which have been collected, it appears that from 4,000 to 5,000 cwt. of stick-lac are annually gathered in the districts of Kumaun, Bareilly, Bulandshahr, Muttra, Farukhabad, and Gházipur. Its price varies between 5 and 6lbs. for the rupee.

Average amount annually produced.

Another dye, cochineal, which, like lac, is of animal origin, may be mentioned here. It is imported from Calcutta, and used, but very sparingly, in silk-dyeing. A specimen of coccus, producing cochineal, has been found in these provinces and in the Panjáb (*vide* Agri-Horticultural Society, Calcutta, Journal, Vol. VII., page 31; Vol. IX., page 135; and Vol. XII., page 32). An attempt was made to introduce this native cochineal into commerce, but the expense of collecting the insects was so great that the experiment resulted in failure.

(2) HARSINGHÁR.

(2) Ver. Harsinghar. (No English name.) An orange dye obtained from the flowers of *Nyctanthes arbortristis; Nat. Ord. Oleineæ.*

Description.—A large shrub or small tree, rough all over, with an uneven epidermis and stiff whitish hairs. Leaves petiolate, entire, or with a few large distant teeth. Flowers sessile, in bracteate fascicles of 3; bracts obovate and fascicles pedunculate and arranged in short terminal trichotomous cymes. Corolla tube orange, limb white.

The *harsinghár* tree is found in most parts of these provinces, though it grows most abundantly at the foot of the lowest range of the Himálayas. It is extremely common on the sides of the hills between Rájpur and Mussoorie. It is well known for the sweet scent of its flowers and their peculiarity in only opening at night. The flowers fall in numbers towards the morning, and are collected either for the dye they yield, or to string in necklaces for native women.

The flowers are simply dried and kept in this state till they are needed for dyeing purposes. They are then boiled, the orange dye being thus extracted from the flower tubes. The cloth is dipped in the infusion and dried. The colour yielded is fleeting. To produce a gallon of infusion of the requisite strength 1lb. of flowers is boiled in 10 gallons of water, 9 gallons being evaporated.

Extraction of the colour.

The colour produced by *harsinghár* used by itself is *buff* or *orange;* it is however much used in combination with other dyes, and some of the best known shades of colour produced are

Shades produced by it.

(2) HARSINGHAR.

noticed below ; those produced in combination with safflower have been noticed under the head of the latter dye.

YELLOW (*Ver. Hartari* of Agra)—	BUFF (*Ver. Kapasi* of Mainpuri)—	MAROON BROWN—
(1) Harsinghár.	(1) Harsinghár.	(1) Turmeric.
(2) Turmeric.	(2) Acidulated water.	(2) Red ochre.
(3) Alum.	*Colour* fleeting.	(3) Myrobalan.
Colour fleeting.		(4) Sulphate of iron.
		(5) Harsinghár.
		(6) Safflower.
		Colour fast.

The chief dyes in company with which *harsinghár* is used are turmeric and safflower ; it appears to be but seldom combined with indigo.

No statistics of area occupied or annual outturn available.

The *harsinghár* tree growing singly or in scattered clumps, it is almost impossible to give any reliable statistics of the area it occupies. For the same reason, any figures which attempt to show the annual produce can only be fallacious. The dried flowers can scarcely be considered an article of trade, and from the reports which have come from the different districts it appears that the quantity produced is nearly, if not quite, all locally consumed.

Price.

The price of the dried flowers varies from 2 to 6lbs. the rupee.

(3) TESU.

(3) Ver. Tesu. (No English name). A yellow dye obtained from the flowers of *Butea frondosa* (*ver. Dhák*) ; *Nat. Ord. Leguminosæ.*

Description.—Young parts downy or tomentose with soft simple hairs; stipules, linear lanceolate, stipels subulate, both tomentose and deciduous. Leaflets coriaceous, hard, clothed with adpressed hairs beneath and a few scattered hairs above, emarginate or rounded at the top, the terminal leaflet broadly obovate from a cuneate base, generally as long as broad, 4-6 inches long, the lateral leaflets oblique ovate, smaller ; lateral nerves 4-8 on either side of midrib, joined by numerous prominent reticulate veins. Flowers fasciculate, in rigid racemes ; pedicels twice the length of the calyx. Branches of inflorescence, bracts and calyx densely clothed with soft ferruginous hairs. Legumes pendulous, tomentose, 4-6 inches long, 1½-2 inches broad. Seed oval, flat, smooth, brown, 1½-2 inches long, 1 inch broad (Brandis.)

This tree is abundant all over the North-West Provinces, growing wild on the open uncultivated plains, often so thickly as to make a jungle called (from the tree) a dhákiana. It is occasionally planted for its timber, being almost the only tree (besides the *Acacia Arabica*) that will do at all well on waste land, the soil of which is impregnated with alkaline substances. In the plains it seldom is more than a stunted shrub ; but in the tarái at the foot of the lowest range of hills it attains the dignity of a tree, and the effect produced in the month of March by its clusters of large orange-red flowers is very striking, and has been often compared to that of a jungle fire.

Extraction of the colour.

The dye is extracted from its flowers by simply pressing them when fresh, or boiling or steeping them, if dried, in a weak solution of lime in water. Four ounces of the flowers are steeped in four quarts of water for 24 hours, when the colouring matter is, so to speak, *wrung out* from the flowers by hand into another vessel. Into this infusion the cloth is dipped, taking a yellow fleeting colour. Though more extensively used than the harsinghár, *tesu* can hardly be termed a dye of commerce. It is much employed during the *Holi* festival, when the Hindus celebrate the triumph of the *Vaishnava* Praládh over the wiles of his heretic father Harnakush with merry-making of a more or less uproarious character. As in the carnival at Rome, masks are in much request, and people carry about a red powder called *abír*, containing particles of mica, which they fling in handfuls over the passers-by. It is also the fashion to colour the clothes for the occasion, and *tesu* from its brilliancy and its fleeting nature is very much used.

Dr. Roxburgh made several experiments with this dye. He writes:—
"Infusions of the flowers, either fresh or dried, dye cotton cloth, previously "impregnated with a solution of alum or alum and tartar, of a most beautiful "bright yellow, which is more or less deep according to the strength of the "infusion. A little alkali added to the infusion changes it to a deep reddish "orange. It then dyes unprepared cotton cloth of the same colour, which the "least acid changes to a yellow or lemon. These beautiful colours I have not "been able to make permanent. Amongst numberless experiments I have "expressed a quantity of the juice of the fresh flowers, which was diluted with "alum water and rendered perfectly clear of depuration. It was then evaporated "by the heat of the sun into a soft extract. This proves a brighter water colour "than any gamboge I have met with. It is now one year since I first "used it, and it remains bright. Infusion of the dried flowers yielded me "an extract very little, if anything, inferior to the last mentioned. They "yield also a very fine durable yellow lake, and all these in a very large "proportion."

The colour produced by dhák flowers used by themselves is a beautiful bright yellow; it is occasionally combined with other dyes, producing shades, the chief of which are noticed below:—

Light yellow (*Ver. Kapási* of Aligarh)—
(1) Tesu (4 oz of dhák flower + 1 oz. of lime).
(2) Limejuice.
Colour fleeting, *cost* 1 anna, *charge* 2 annas.

Grape green (*Ver. Anguri* of Cawnpore)—
(1) Indigo.
(2) Tesu.
(3) Harsinghár.
(4) Acidulated water.

Light blue (*Ver. Lajwárdi* of Cawnpore)—
(1) Tesu (4 oz. of dhák flower + 1 oz. of lime).
(2) Alum, 1 oz.
(3) Powdered talc, 30 grains, mixed with dhák flower.
(4) Indigo.
Colour partly fleeting, *cost* 1½ anna, *charge* 8 annas.

(3) Tasu.

As in the case of the harsinghár, no statistics can be given of the area occupied by the dhák tree, nor of the average annual produce in dye. The tree is one of the commonest *jungle* trees in the North-West Provinces and occurs in almost every district in patches.

Area occupied and average annual produce in dye.

In most cases the flowers can be obtained for the trouble of picking them up and drying. Their price varies between 27lbs. and 164lbs. to the rupee.

From the dhák tree a gum is obtained which is used in precipitating indigo (*vide* page 7) and in calico-printing. Dr. Roxburgh gives the following description of it :—

"From natural fissures and wounds made in the bark during the hot season "there issues a most beautiful red juice, which soon hardens into a ruby-"coloured, brittle, stringent gum, but it soon loses its beautiful colour if "exposed to the air. To preserve the colour it must be gathered as soon as it "becomes hard and kept closely locked up in a bottle."

Lac is frequently obtained from the branches of the dhák tree.

(4) Tun.

(4) Ver. Tun. (No English name.) A yellow dye obtained from the flowers of *Cedrela toona ; Nat. Ord. Meliaceæ.*

Description.—Leaves abruptly pinnate, 12-18 inches long, glabrous ; leaflets generally opposite, 10-20 petiolulate, lanceolate, or ovate-lanceolate, acuminate or slightly undulate (toothed in South India) ; panicles terminal, pubescent, nearly as long as leaves, pendulous, the lower ramifications frequently in the axils of leaves ; flowers white with a fragrance like honey ; calyx flat, 5-cleft, lobes ciliate, obtuse ; petals oblong, ciliate ; stamens 5, inserted on 5 fleshy, orange-coloured hairy lobes of the disc ; sterile filaments none ; stigma peltate, 5-lobed ; capsule oblong, ¾-1 inch long ; seeds with membranous wings at both ends (Brandis.)

The *tún* is a valuable forest tree largely found in the districts of Muzaffarnagar and Meerut, as well as in those which lie immediately under the Himálayas. It abounds on the lower ranges of hills between the elevation of 2,000 and 4,000 feet, and often attains a height of 80 feet, with a girth of 10 feet.

The white fragrant flowers bloom in the months of May and June. The yellow dye is extracted by boiling them in water till three-fourths of the latter is evaporated. The cloth is simply dipped in the infusion, taking a yellow fleeting colour known as *basanti.*

Extraction of the colour.

A red dye is occasionally extracted from the seed.

Basanti is but seldom combined with other dyes : it is generally used for dyeing women's clothes and men's turbans. It was a more common practice under native rulers than it appears to be now to wear *basanti*-coloured clothes in the spring, whence its name "*basant*," being Hindi for *spring time.* The following are the chief shades of colour produced by it :—

Shades of colour produced.

(4) TUN.

SULPHUR YELLOW (*Ver. Basanti* of Cawnpore)—

(1) Tún flowers, 4 oz.
(2) Turmeric, 2 oz.
(3) Lime, 2 oz.
(4) Acidulated water.

Cost 1 anna, *charge* 3 annas.

ORANGE (*Ver. Champai* or *Sonhaila* of Tirwa in Farukhabad district)—

Safflower, 1 oz., mixed with *tún* flowers, 2 oz.

Colour fleeting.

No statistics can be given of the area occupied by the tún tree or of the average quantity of dye produced.

The price of the dried flowers varies from 5lbs. to 12lbs. per rupee.

(5) MARIGOLD.

(5) Marigold (Ver. Genda.) A yellow dye extracted from the flowers of *Tagetes erecta* and of *T. patula* (the marigold); *Nat. Ord. Compositæ.*

Description—Receptacle naked; pappus of five erect awns; calyx 1-leaved, 5-toothed; florets of the ray four or five permanent; annual, erect, ramous; leaves lanceolate, ciliate-serrate; peduncles naked, 1-flowered (Roxburgh.)

The marigold is a common garden plant in these provinces. The dye is extracted from its flowers in the same manner as from the dhák (*Butea frondosa*): they are soaked in water and squeezed by hand. The dye is but little used by dyers, though the common people not unfrequently dye their own clothes with it. The shade of yellow known as *gendia* is produced by it, and it is occasionally used in place of *harsinghár* or turmeric in producing the colour *champai.*

(6) ARUSA.

(6) Arusa (No English name.) A yellow dye extracted from the leaves of *Adhatoda vasica; Nat. Ord. Acanthaceæ.*

Description.—Shrub, 8-10 feet; leaves opposite, lanceolate: corolla monopetalous, irregular; stem much branched; flowers on short spikes, terminal; flower whitish, spotted, sulphur-coloured at the throat and at the limb with dark purple lines (Drury.)

This evergreen plant, sprouting during the rains, produces when the rains are over a lovely appearance with its blossoming flowers. The yellow dye is extracted from the leaves by boiling them in water (in the proportion of 10lbs. to 16 lbs.) till half the water has evaporated. It is generally used by the country people only in dyeing coarse cloths, though the colour it gives is permanent. Besides yellow, dark-blue green is produced by it in combination with indigo.

The price of *arusa* leaf is 40lbs. to 50lbs. per rupee.

(7) HENNA.

(7) Henna (Ver. Menhdi.) An orange dye extracted from the leaves of *Lawsonia alba; Nat. Ord. Lythraceæ.*

Description.—Shrub, 6-10 feet; calyx 4 partite; petals 4 unguiculate, alternate with the lobes of the calyx, obovate, spreading; stamens in pairs alternating with the petals; leaves opposite, oval-lanceolate, quite entire, glabrous; flowers panicled; ovary sessile, 4-celled; capsule globose, 3-4 celled; seeds numerous; flowers white or pale greenish (Drury).

The *menhdi* abounds all over these provinces, and is one of the commonest shrubs grown in hedges. The dye obtained from its leaves is chiefly used by native women, who dye their finger-nails a dull orange colour with it. It is also

(7) HENNA. used for dyeing the hair. Used in combination with a decoction of myrtle leaves a purplish black colour is obtained. Dr. Roxburgh writes of the plant:—

"The leaves yield in decoction porter-coloured liquor. I have found it "a deep orange colour which acids destroy, while alkali and infusions of "astringent vegetables deepen it. This decoction dyes the finger of a "deep orange, but does not communicate any colour variously prepared, nor "could I produce any precipitate from the decoction worth attending to."

A decoction of the leaves is occasionally used in dyeing cloth; the only colour reported to be produced from it is a shade of light reddish brown known as *málagíri*.

(8) INDRAJAU. **(8) Ver. Indrajau. (No English name.)** A blue dye extracted from leaves of *Wrightia tinctoria; Nat. Ord. Apocynaceæ.*

Description.—Shrub, 10-15 feet; leaves elliptic-lanceolate or ovate-oblong, acuminated, glabrous; panicles terminal, branches and corymbs divaricate; tube of corolla twice as long as the calyx; follicles distinct but united at the apex; flowers white, fragrant, 1½ inch in diameter when expanded (Drury.)

Bundelkhand seems to be the only locality in the plains of these provinces where the *indrajau* is found.

A full description of it is given in the Journal of the Calcutta Agri-Horticultural Society, Vol IV. It is mentioned there that indigo is extracted from the leaves, but there is no information of such being done in these provinces. The seeds alone are reported to be used here with red dyes to give a permanency to the colour, and this too but seldom.

(9) BABUL. **(9) Babul. (No English name.)** A black dye obtained from the legumes of *Acacia Arabica; Nat. Ord. Leguminosæ.*

Description.—Tree, 30-40 feet, armed with stipulary thorns; leaves bipinnated; pinnæ about 5 pairs; leaflets 15-20 pair, glabrous; peduncles aggregated, axillary or forming a raceme by the abortion of the leaves; heads of flowers globose; stamens distinct; legumes stalked, thickish, contracted on both sutures between the seeds; flowers small, bright yellow, fragrant (Drury.)

Balfour, concerning the babúl, remarks that "this tree is found in every "district of India, and is worthy of cultivation on account of its gum, timber, "and its seeds, a favourite food of sheep, &c. It is of rapid growth and "requires no water, flourishing in dry arid plains, and especially in black cotton "soil, where other trees are rarely met with. Like several others of the "same genus, it yields abundance of transparent gum, which is used in India "as a substitute for gum-arabic. The bark is extensively employed in "tanning, and with proper management makes a good leather, imparting a "reddish tinge. The seed-pods (legumes, *ver. babúl singri*) are used as a sub-"stitute for the more expensive dye stuffs and for communicating shades of "drab to cotton."

(9) BABUL.

In these provinces the legumes are pounded and boiled. Cloth dipped in the decoction takes the black colour known as *siyah bhura*; if subsequently dipped in a solution of sulphate of iron, the black changes to the brown colour *agrai khaki*. Both colours are fast.

Extraction of the dye.

The following statement shows the amount of babúl legumes exported from the forests of the North-West Provinces in the years 1874-75 and 1875-76:—

Anual export from N.-W. P. forests.

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor district, Najíbabad forest ...	11	90	3⅜	30
Garhwál	14	114	10¼	84
Kumaun	13⅛	216	15⅜	252

The bark of the babúl tree is a valuable tanning agent, and the gum it produces is used in calico-printing.

(1) KAMILA.

(10) Kamila. (No English name.) An orange dye prepared from the fruit powder of *Mallotus Philippinensis; Nat. Ord. Euphorbiaceæ.*

Description.—Small tree or undershrub; younger branchlets petioles, and inflorescences rusty tomentose; leaves rhomb-ovate, acuminate, acute at the base, entire or slightly toothed, clothed with scarlet tomentum beneath, glabrous above; spikes of either sex axillary and terminal, rusty tomentose; male bracts 3-flowered, female 1-flowered; bracts triangular-ovate, acute; segments of the female calyx ovate-lanceolate; stamens 12-15; ovary densely scarlet; capsules slightly 3-cornered, globose, covered with scarlet dust (Drury.)

The *kamila* or monkey-face tree (monkeys are said to rub their faces in its fruit) is found in the forests of the North-West Provinces, as well as in the Deccan, Northern Sircars, and Sikim. The dye obtained from its fruit is used in dyeing silk and wool, giving a rich flame colour of great beauty and permanence. It does not require a mordant, all that is necessary being to mix it with water containing about half its weight of carbonate of soda. The dye was very favourably reported of by the jurors of the Madras Exhibition as being especially valuable for silk. The bark of the tree is used in tanning leather. It is imported into these provinces from the Sub-Himálayan forests and Calcutta, and sells in the bazar at Rs. 22 per cwt. When used, it is simply pounded and dissolved in water.

The following statement shows the exports from the forests in 1874-75 and 1875-76:—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs		Rs.
Bijnor district, Najíbabad forest ...	18½	300	22	360
„ Rehar	1½	16	1½	16
Garhwál	2¼	36	1⅝	26
Kumaun	339	9,723	372	10,668

(11) CATECHU.

(11) Catechu (Ver. Kath or Khairi, the Terra Japonica of Commerce). A dark-brown dye obtained from the heart-wood of *Acacia catechu; Nat. Ord. Leguminosæ.*

Description.—Tree, 30-40 feet; branches armed with stipulary thorns, occasionally unarmed; leaves bipinnated; pinnæ 10-30 pair; leaflets numerous; young shoots, petioles, and peduncles more or less pubescent; petioles sometimes armed below with a row of prickles; spikes axillary, 1-4 together, shorter than the leaves; corolla 5-cleft; petals united; stamens distinct; legumes thin, flat, glabrous, 4-8 seeded; flowers small, white or pale yellow (Drury.)

A full description of catechu manufacture, under the name of *khairi*, is given in Madden's *Account of the Outer Hills and Tarái of Kumaun*, quoted in the *Panjáb Products*, page 472 :—"The "manufacture of catechu is carried on by men, women, and children, the "manufacturers being distinguished by the appellation of *khairi*. The men "search for trees which are best suited for the purpose and fell them. A "*khair* tree good for yielding catechu is known by its having an abundance "of red heart-wood. The trees being felled, the wood is cut into chips. Long "shallow furnaces with covered convex roofs are erected under sheds, the "convex covering of the furnace being pierced along the centre to admit "of about 20 ordinary earthen pots being placed over the fire. The pots are "filled with chips and water and boiled till the contents of the 20 pots will "fill two. The liquid infusion looks like thin port wine. This is set aside to "cool, and the catechu coagulates and crystallises over leaves and twigs "thrown into the pot for the purpose, Each pot yields about 2lbs. of an "ashy whitish colour.

Mode of preparation in Kumaun.

"Women and children are employed to watch the boiling pots during 20 "hours; this is managed by relays of people. The chips of wood, after the "catechu has been extracted, are dried and used for fuel. Each furnace pays a "tax of Rs. 4 to the Government. The catechu manufacture is carried on until "the rainy season begins.

"The best samples of catechu are clean and whitish or pink colour, but some "are in dirty pieces much mixed with earth: this is inferior."

In the *Kheri* Pass and the *Dún* the catechu is not allowed to crystallise in this manner, but is poured into clay moulds and thus made into cakes.

In the Dún.

Kath is prepared for dyeing purposes by being steeped in water with a little lime. The infusion is then strained off and is ready for use. It contains two distinct principles, tannin and catechine; the latter is insoluble when oxidised, and it is on this property that its permanence as a dye depends. In England the oxidising agent generally used is a salt of copper in company with sal-ammoniac. Perhaps the best known use of *kath*, however, is as an ingredient in the prepared *pán* leaves generally

Uses in dyeing.

chewed by the natives of this country. The *kath* is pounded fine, and a little is then smeared on the *pán* leaf together with some white lime and crushed betel-nuts. It is the *kath* in combination with the lime which gives to the teeth and lips the red colour so unsightly to European eyes. (11) CATECHU.

The shades of colour produced by *kath* are various tints of brown.

The quantity of catechu exported from the Kumaun forests during the year 1874-75 was 411½ cwt., valued at Rs. 16,860, and in 1875-76, 249 cwt., valued at Rs. 10,200.

(12) Ver. Darhaldi or Kilmora. (No English name.) A yellow dye obtained from the bark and root of *Berberis tinctoria (aristata)* and *B. lycium; Nat. Ord. Berberidacæ.* (12) DARHALDI.

Description.—Shrub, 6-10 feet; leaves simple, obovate, entire, or with distant, small, spiny teeth, glaucous, with the principal veins and nerves prominent beneath, but not above; racemes stalked, longer than the leaves; pedicels slender; petals 6, distinctly biglandular; sepals 5, spines deeply divided into three sharp, rigid segments; flowers yellow; berries 2-3 seeded (Drury.)

Both species of *Berberis* are very common in the districts of Kumaun and Garhwál; the former keeps to the higher, the latter the lower elevations. *Berberis aristata* has been found on the borders of perpetual snow in the Himálayas, but stunted to the size of a mountain gooseberry, side by side with which it was growing. Professor Solly, as quoted in the Journal of the Agri-Horticultural Society, Calcutta, (IV., 272-279), gives an important paper on the subject of this tree. He notices its importance as an excellent yellow dye for leather, and writes:—"The colouring principle is found in the bark and wood of the stem, "as well as in the root, but the root only has, I believe, been applied in dyeing. "In the specimens which I have seen the colouring matter was in the stem, for "the most part collected together in the bark and round the circumference. A "considerable portion was also deposited around the pith, particularly in the "larger stems, whilst the great bulk of the woody fibre intervening contained "very little colour. The root, however, was wholly of a fine yellow colour. In "the larger stems the proportion of useless woody fibre to the bark and "parts yielding colour is undoubtedly large, but this is quite compensated by "the superior richness of colour in the old stems."

(13) Lodh. (No English name.) A yellow dye extracted from the bark of *Symplocos racemosa* and *Symplocos paniculata; Nat. Ord. Styraceæ.* (13) LODH.

Description.—(*S. racemosa*) Tree; leaves oblong-lanceolate, acuminate, acute at the base, quite glabrous, sub-denticulate, shining above; racemes simple, axillary, nearly equalling the petiole, hairy; sepals and bracteoles ovate, obtuse, ciliated; ovary free at the apex; flowers small, yellow (Drury.)

The *lodh* tree in these provinces is confined to the forests of the Bijnor, Kumaun, and Garhwál districts. The bark is imported in some quantities from

(13) LODH. Calcutta, and is used in calico-printing and dyeing leather as an auxiliary to other dyes, being usually pounded up and mixed with them.

The following statement shows the exports of *lodh* from North-West Provinces' forests in 1874-75 and 1875-76 :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor District, Najíbabad forest ...	87¾	180	256½	650
Garhwál	71½	119	161¾	280
Kumaun	36	71	42½	73

(14) NÁSPÁL. **(14) Ver. Náspál (Pomegranate rind).** A greenish brown dye obtained from the fruit rind of *Punica granatum ; Nat. Ord. Myrtaceæ.*

Description.—Tree, 15-20 feet ; leaves opposite, oblong lanceolate ; calyx 5-cleft ; petals 5 ; fruit globose, crowned by the tubular limb of the calyx ; seeds numerous, covered with a pellucid pulp ; flowers nearly sessile scarlet (Drury.)

The pomegranate *(ver. anár)* is cultivated in gardens not for its dye, but for its fruit. It grows wild in the hilly districts of Kumaun and Garhwál. The dried rind of the fruit is called *náspál*, and is imported in considerable quantities from the hills bordering on these provinces. The rind is ground and boiled, giving a decoction of greenish colour. Occasionally this is used alone in dyeing cloth the colour known as *kakrezi* (greenish brown), but it is more generally used in company with some other dye as a colour concentrator, in which case the pulverised rind is boiled along with the dye. Should it be used alone, the rind is boiled in water till three-fourths of the latter has evaporated. The cloth is simply dipped in this infusion.

Like myrobalan, *náspál* is used in fixing the colour of turmeric in yellow and orange shades, and turmeric combined with indigo in the various shades of green. Myrobalan is more used than *náspál* with mineral dyes, such as sulphate of iron, &c.

The only colour in the production of which *náspál* seems to take a part is—

BROWN (*Ver. Kakrezi* of Benares)—

(1) Myrobalan, ½lb.
(2) Náspál, 4oz.
(3) Sappan wood, 4oz.

In all other cases its use would appear to be that of fixing or clearing the colours, and it is thus used in dyeing shades on which its own colour would have but little effect.

Area occupied and average annual produce.

Neither the approximate area occupied by the pomegranate tree nor the average amount of *náspál* annually produced is discoverable.

Náspál is extensively used in tanning and dyeing morocco leather. (14) NÁSPÁL.

Price. Its price varies from 3lbs. per rupee in Meerut to 82lbs. per rupee in Garhwál.

(15) Myrobalan. (Ver. Harra.) A grey dye obtained from the outer rind of the fruit of the *Terminalia chebula.* (15) MYROBALAN.

Description.—Tree, 40-50 feet; leaves nearly opposite, shortly petioled, ovate oblong, obtuse or cordate at the base, quite entire, when young clothed with glossy silky hairs, particularly above, adult ones glabrous, sometimes glaucous, upper surface inconspicuously dotted, under closely reticulated with purplish veins; glands one on each side at the apex of the petiole; spikes terminal, often panicled; drupes oval, glabrous; nut irregularly and obscurely 5-furrowed; flowers small, whitish, fetid (Drury.)

Drury in his *Useful Plants* gives the following economic uses of this tree:—"The outer coat of the fruit of this tree mixed with sulphate of iron makes "a very durable ink. The galls are found on the leaves produced by insects "puncturing the tender leaves. With them and alum the best and most durable "yellow is dyed, and in conjunction with ferruginous mud black is procured "from them. The fruit is very astringent, and on that account much used by "the Hindus in their arts and manufactures." The following account of *Terminalia* by Mr. Barnes is quoted in the *Panjáb Products*:—"These trees are "very valuable. The produce of a single tree will sell for Rs. 2,000. It flowers "in May. The fruit ripens in September or October, and consists of a nut "enclosed in a thin exterior rind. The rind is the valuable part. It is used as "an aperient, and has also tonic properties calculated to promote digestion."

The dyers pound the outer rind of the fruit and mix it with water: the cloth is simply dipped in this mixture.

The chief shades of colour with the production of which myrobalan enters are *black* in company with sulphate of iron, *green* in company with turmeric and indigo, *dark blue* in company with indigo, and *brown* in company with catechu. It is used more as a concentrator of colour than as contributing much colour of its own.

Two varieties of myrobalans are known in the markets of these provinces; the large called the *moti harra*, and the small *jangi harra*. The following statement shows the export of each kind from the forests of the North-West Provinces during the year 1874-75 and 1875-76:—

Name of forest from which exported.	1874-75.				1875-76.			
	Large.		Small.		Large.		Small.	
	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.
Najíbabad	73½	125	36½	400	36¼	100	18¼	200
Rehar	¾	4	¾	6	¾	4	1½	12
Dehra Dún	22	45	...	...	6½	13	...	...
Garhwál	307½	630	126	1,204	124¼	255	29¼	280
Kumaun	47½	170	42½	406	2¾	8	31½	301

(15) MYROBALAN.

There is another species of *Terminalia* (*T. bellerica*), the fruits of which are much used in tanning; it will be specially noticed in Part III. of this report.

(16) MAJUPHAL.

(16) Ver. Majuphal. A greyish dye obtained from the gallnuts of *Quercus; Nat. Ord. Cupuliferæ.*

The real gall or dyer's oak (*Quercus infectoria*) is found in Greece, Asia Minor, and Syria; it is believed, however, that some of the gallnuts used in these provinces are obtained from oak trees in the Kumaun, Garhwál, and Bijnor forests. The best gallnuts used by dyers are, however, chiefly imported from Calcutta.

In dyeing, the galls are boiled in water in the proportion of 2oz. of the former to a quart of the latter, till three-fourths of the water is evaporated. The cloth is then dipped in the decoction.

Extraction of the colour.

Májuphal is used in producing the following colours:—

BROWN (*Ver. Kishmishi* of Allahabad)—
(1) Myrobalan.
(2) Turmeric.
(3) Alum.
(4) Májuphal.
(5) Safflower.
Cost ½ anna, *charge* 4 annas.

GREY (*Ver. Pistai* of Meerut)—
(1) Indigo.
(2) Alum.
(3) Májuphal.
Colour fast, *cost* 1 anna, *charge* 2 annas.

LAVENDER (*Ver. Dudhia Khaki* of Aligarh)—
(1) Májuphal.
(2) Sulphate of iron.
(3) Alum.

Another kind of small irregularly rounded galls is obtained from the twigs of the *farash* (*Tamarix articulata*) by the puncture of an insect. This gall is the *mai farash* of Indian dyers and calico-printers.

(17) AONLA.

(17) Aonla. (No English name.) A blackish dye obtained from the fruit of *Emblica officinalis; Nat. Ord. Euphorbiaceæ.*

Description.—Tree; leaves alternate, bifarious, pinnate, flower-bearing: leaflets numerous, alternate, linear obtuse, entire; petiolate, round; calyx 6-parted; flowers in the *male* very numerous in the axils of the lower leaflets, and round the common petiole below the leaflets; in the *female* few, solitary, sessile, mixed with some males in the most exterior floriferous axils; stigmas 3; drupe globular, fleshy, smooth, 6-striated; nut obovate-traingular, 3-celled; seeds 2 in each cell; flowers small greenish yellow (Drury.)

The fruit is pound and boiled with water, the cloth to be dyed being dipped in the decoction. The only colour in the production of which it is used is that known as *abunsi*, a shade of blue-black, and then it is mixed with myrobalan and plays the part more of a colour concentrator than of a dye, the black colour being produced by the sulphate of iron used.

Extraction of the colour.

The leaves of the *aonla* tree are much used in tanning leather. In 1875-76, 128 cwt. of *aonla* leaf, valued at Rs. 4, were exported from the Gorakhpur forests for this purpose.

(18) Ver. Bael or bel. (No English name.) The fruit of *Ægle marmelos; Nat. Ord. Aurantiaceæ.* (18) BAEL.

Description.—Tree, middling size, armed with sharp spines; leaves pinnate; leaflets oblong or broad lanceolate, crenulated, unequal, middle one petiolate, lateral ones almost sessile; petals 4-5, spreading; stamens distinct; style short, thick; flowers in panicles, axillary, on long pedicels, large, greenish white, fragrant; berry with a hard rind, smooth, many-celled, many-seeded; seeds covered with a transparent glutinous matter (Drury.)

A tree growing commonly in these provinces. Its fruit is occasionally used with myrobalan by calico-printers, and has a market price of about Rs. 4 per cwt. It is however far better known for its sweet juice, which makes it one of the favourite fruits of the country. It is used in medicine as an aperient and is a well-known remedy for dysentery.

(19) Dha. The flowers of *Grislea tomentosa* (*Nat. Ord. Lythraceæ*), used more in refining the colour of *ál* (see page 18) than as a dye. (19) DHA.

Description.—Shrub or small tree; branchlets pubescent; leaves opposite, entire, lanceolate, somewhat cordate at the base, sessile, under side hairy, smoothish above; petals usually 6, scarcely conspicuous; stamens declinate; capsule oblong; calyx tubular, sharply toothed; seeds numerous; peduncles axillary, many-flowered; flowers red (Drury.)

The water in which *ál* is to be boiled is often prepared by having *dha* flowers soaked in it. A decoction of the flowers is used in the Panjáb for dyeing silk.

The leaves and twigs yield a yellow dye called *nauti*, occasionally used in calico-printing.

The following statement shows the import of the *dha* flowers into these provinces in 1874-75 and 1875-76:—

Whence imported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor District, Najíbabad forest ...	73½	100	55	112
Rehar	¾	1	¾	1
Garhwál	249	510	49¾	102
Kumaun	216	369	154½	264

(20) Ver. Tejpat. (No English name.) The leaves of *Laurus cinnamomum; Nat. Ord. Laurineæ.* (20) TEJPAT.

Description.—A handsome, moderate sized tree; young twigs 4-sided, greenish grey, glabrous, smooth; leaves sub-coriaceous, opposite or sub-opposite, rarely alternate, elliptic-oblong, from an acute base acuminate, 3-6 inches long, glabrous, shining, the midrib dividing some distance (up to ½ inch) above the base into three longitudinal nerves, joined by distinct reticulate veins; flowers whitish, numerous, in axillary and terminal pubescent panicles, pedicels as long as calyx; calyx silky pubescent, lobes membranous, with 3-7 distinct longitudinal nerves, ovate-oblong, obtuse, separating in a tranverse line above the base, but below the middle, and falling off after flowering; berry black; when ripe, succulent, ovoid, ½ inch long, supported by the 5-lobed somewhat thickened base of the calyx (Brandis.)

(20) TEJPAT.

Tejpát is imported largely from Nepal and from the North-West Provinces' forests, and is used, together with myrobalan, chiefly in calico-printing, apparently as a clarifier.

The following statement shows the amount of *tejpát* exported from the North-West Provinces' forests in the years 1874-75 and 1875-76:—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor District, Najíbabad forest ...	36½	62	18¼	37
Garhwál	14¾	30	35	72
Kumaun	88½	272	120¾	374

(21) VEGETABLE ACIDS.

(21) **Acids** are chiefly prepared from the leaves, flowers, and fruits of the tamarind (*Tamarindus Indica*), and from the fruits of the mango (*Mangifera Indica*) and lime.

They are much employed in dyeing to assist in fixing the dye on the cloth, and especially in the case of safflower, which is seldom used without an acid of some sort.

MISCELLANEOUS VEGETABLE DYES.

In concluding the list of vegetable dyes produced in the North-West Provinces four other substances may be noticed:—

The flower of the cotton plant (*Gossypium indicum*) is said to be sometimes used as a yellow dye in the Mainpuri district, and the seeds of the *charkhunda* (*Cassia tora*) in the Jaunpur district. The leaf of the *pân* (*Chavica beel*), which is chewed by nearly every Hindu in the country, is said to be used at Kanauj for colouring the border of a kind of chintz made there called *fard pokhta*. The powdered dry root of *amahaldi* (*Curcuma zerumbet*) mixed with powdered sappan wood is one of the recipes for *abír*, the red powder which Hindus use at their carnival of the *Holi*. People throw it over one another much as "confetti" are thrown at Rome.

(*b*) *Scents used in dyeing.*

There are three vegetable substances deserving notice as being employed in dyeing, not from any effect they exert on the colour or colouring process, but simply in order to give fragrance to the cloth.

(1) KAPUR KACHRI.

(1) **Ver. Kapur Kachri. (No English name.)** The root of *Hedichium spicatum*, a native of China as well as of the Sub-Himálayan forests. Externally the root is of a reddish colour, internally it is white or whitish. It is used (like ordinary camphor) to preserve clothes from attacks of insects, and

occasionally in dyeing and calico-printing, to give a fragrance to the cloth, especially to the kind known as *malagíri* dyed with henna. In this latter case it is mixed with *charíla* and *nagarmotha* and a decoction made of all three substances. The following statement gives the exports of *kapur kachri* from the North-West Provinces' forests during the year 1875-76 :— (1) KAPUR KACHRI.

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor District, Najíbabad forest,	36½	75	40⅓	120
Garhwál ...	106⅞	290	95 1/10	260
Kumaun ...	50½	155	95⅞	293

(2) Ver. Charila or Charpuri. (No English name.) Is a lichen (*Parmelia chamchadahis*) which grows amongst the rocks of the Himálayas, from whence it is imported into these provinces, *viâ* Bareilly and Pilibhít. It is also found in the forests of the North-West Provinces. Like *kapur kachri*, it is used as a perfume in calico-printing. Its price is about Rs. 5-8-0 per cwt. (2) CHARÍLA.

The exports of *charíla* from the North-West Provinces' forests during the years 1874-75 and 1875-76 are shown in the following statement :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor District, Najíbabad forest,	73½	125	91½	187
Garhwál ...	95⅞	195	197	403
Kumaun ...	248	424	357½	610

(3) Ver. Nagarmotha. (No English name). The root of *Cyperus longus* or *Cyperus pertennius ; Nat. Ord. Cyperaceæ.* (3) NAGAR-MOTHA.

This plant is found over all these provinces, the roots being dug out of the fields after the spring harvest. They are used in dyeing to give a scent to the cloth.

(*c*) *Dyeing auxiliaries.*

The following are the chief auxiliaries of vegetable origin used in dyeing :—

Wheat and rice flour, employed as paste in calico-printing.

Castor and other vegetable oils, used in bleaching.

GUMS.

Gums are used in assisting the precipitation of indigo fecula (*vide* page 7), and are mixed with the colours in calico-printing to make them thicker and more tenacious. The gum most often employed is a mixture of babúl gum (*Acacia Arabica*) with that of the *bankri* (*Anogeissus latifolia*). Babúl gum is also used as a starch.

The subjoined table shows the amount of gum exported from the North-West Provinces' forests during the years 1874-75 and 1875-76:—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor district, Najíbabad forest ...	117	290	311	1,000
Rehar	22	90	22	90
Dehra Dún	2	12	1½	6
Garhwál	41	224	72½	396
Kumaun	26½	334	106	943

Kanda is the impure gum which exudes naturally, and not from cuts made in the bark, and which has been hardened by undue exposure to the air. It is frequently used as a substitute for gum in calico-printing.

The subjoined table shows the exports of *kanda* in 1874-75 and 1875-76 from the forests of the North-West Provinces:—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Bijnor district, Najíbabad forest ...	...	...	439½	600
Dehra Dún	...	...	107	36
Garhwál	1,075	1,469	881	1,252
Kumaun	239½	736	85	261

The price of *kanda* is about Rs. 3 per cwt in the plains.

In "gums" and "kanda" are included the following substances:—

Kani, the gum of the babúl, Acacia Arabica (7).
Bankri (*or dhao*) ditto Anogeissus latifolia (13).
Dha, ditto Grislea tomentosa (16).
Piár, ditto Buchanania latifolia (12).
Dhák, ditto Butea frondosa (22).
Sandrao, ditto Vateria Indica (31).
Mochras, ditto Bombax Malabarica (27).

The last two are not produced in these provinces, and are noticed here for the sake of convenience. There are *two* substances known as *mochras:* one an exudation from the areca palm, the other the gum noticed here. The numbers in

brackets refer to pages in the "Gums and Resins of the North-West Provinces," by E. T. Atkinson, Esq.

Gurh or unrefined sugar is the result of boiling the canejuice in shallow iron pans to the consistence of gum, when it is made up into round balls (*bhelis*) or cakes. In this form most of the people of this country eat their sugar. *Gurh* is used to quicken the fermentation of indigo (*vide* page 9) and also in the preparation of sulphate of iron (see below).

I. B.—MINERAL DYE SUBSTANCES PRODUCED IN THE NORTH-WEST PROVINCES.

(*a*) *Dyes and colouring matter.*

There are only three mineral dyes produced in these provinces which deserve especial notice—sulphate of iron, the red earth called *geru*, and black earth, better known as the "cotton soil" of the Bundelkhand and the Central Provinces.

(1) SULPHATE OF IRON.

(1) Sulphate of iron gives a black dye and is very extensively used for this purpose. The process of preparing it varies, but may generally be described thus: Into water in which sufficient coarse sugar has been dissolved is thrown iron which has been heated to a red heat and cleaned. The weight of iron used is about four times that of the sugar dissolved. It is left to steep in the liquid from four to eight days, being occasionally stirred: when the solution has become of a deep black colour it is ready for dyeing purposes. Occasionally myrobalans are boiled with it to clear the colour.

Cloth is dyed by being steeped in the mixture.

The chief colours produced by sulphate of iron are—

BLACK (*Ver. Paundái* of Etah)—

(1) Myrobalans.
(2) Alum.
(3) Washed in clear water.
(4) *Ál.*
(5) Sulphate of iron.

Colour fast, *cost* 4 annas, *charge* 8 annas.

Safflower is sometimes substituted for *ál*, when the colour loses permanence, but gains in brilliancy; the charge is increased to 12 annas.

BLUE-BLACK (*Ver. Kalejái* of Allahabad)—

(1) Myrobalan.
(2) Sulphate of iron.
(3) Indigo.
(4) Safflower.

Colour fleeting.

DARK-GREEN (*Ver. Zimmaraddi* of Cawnpore)—

(1) Myrobalan, 2 oz.
(2) Sulphate of iron, 2 oz.
(3) Turmeric, 2 oz.
(4) Náspál, 3 oz.
(5) Alum.
(6) Acidulated water.

Colour fast, *cost* 1½ anna, *charge* 2½ annas.

DARK-BROWN (*Ver. Kakrezi* of Farukhabad)—

(1) Lac. | (2) Sulphate of iron.

Colour fast, *charge* 8 annas.

Used with catechu to give various shades of brown.

SLATE GREY (*Ver. Khâki* of Allahabad)—

(1) Myrobalan. | (2) Oak-galls, 12 grs., and sulphate of iron, 90 grs., mixed together.

Colour fast.

Sulphate of iron is also much used in calico-printing.

(2) RED OCHRE.

(2) Red ochre. (Ver. Geru). Impure Sesqui-oxide of Iron. This substance is found in some parts of these provinces and is extensively imported from Gwalior. It is much used by fakírs and ascetics for dyeing their clothes of a dull orange colour, but plays a more or less important part in the hands of the dyers in the production of several well-known colours. The earth is simply pounded and mixed with water, into which the cloth is dipped.

Red ochre of a lighter colour than *geru* is known as *hirmji*, while yellow ochre (hydrated sesqui-oxide of iron) is occasionally used as a dye under the name of *rámraj*.

The following are examples of the various shades produced by *geru*:—

BUFF (*Ver. Geru* of Mainpuri and Allahabad)—

(1) Red earth. | (2) Alum.

Colour fleeting.

DOVE GREY (*Ver. Fáktái* of Cawnpore)—

(1) Myrobalan. | (3) Alum.

(2) Sulphate of iron, | (4) Red earth.

Cost ½ anna, *charge* 2½ annas.

PURPLE (*Ver. Nafarmáni* of Allahabad and Bánda)—

(1) Safflower. | (2) Indigo mixed with red earth.

The red earth is sometimes mixed with safflower instead of indigo. *Geru* is also used in calico-printing.

(3) BLACK EARTH.

(3) Black earth is occasionally used with the gum of *Acacia Arabica* to produce a shade of blue-black.

(b) Dyeing auxiliaries.

The other mineral substances used in dyeing, which are produced in these provinces, are various alkaline earths which deserve but a very brief notice, since the method of their use is described under the heading of the dyes with which they are employed.

(1) Reh (Impure Carbonate or Sulphate of Soda) are the salts which by their efflorescence have rendered so much land in these provinces uncultivable. They are used as soap in washing cloth, a preliminary in calico-printing.

(2) Saltpetre is found effloresceing on the ground surrounding villages, on old village sites, whence it is collected and purified by a class of men called *nonaris*. A distillation of it is used in wool-dyeing.

(3) Rassi is carbonate of soda; prepared from *reh* by dissolving it in water and precipitating foreign substances. Like *reh* it is used as a soap.

(4) Sajji is a mixture of carbonate of soda and potash. It is made by dissolving in water, wood-ashes and *reh*, and exposing them to the sun for four or five days. It is used in bleaching and also in extracting the crimson dye from safflower (*vide* page 13).

(5) Potash is generally obtained from the ashes of the stalks of *bajra* (millet, *Penicillaria spicata*), cultivated all over the country as an autumn food crop. The *potash* is used, like *salt*, in extracting the crimson dye of safflower, and also occasionally in calico-printing.

(6) Lime is used in calico-printing in combination with a gum as a "resist paste." It is also employed with sugar to excite fermentation in indigo and convert it into "indigo white" in the presence of hydrogen.

Lime is obtained in these provinces by burning *kankar*, the calcareous formation found in beds a few feet below the surface in most parts of the country, with which most of the roads are metalled.

All these last-mentioned mineral substances are used in tanning, and will be again noticed under that heading.

The following substances of *animal* origin scarcely deserve notice :—*Dung* is used in washing cloth preparatorily to dyeing or calico-printing, and, subsequently, to extract the unprecipitated mordant; *buffalo's milk* acts as purifier to the colour derived from sappan wood; and a paste made of wheat-flour and clarified butter, called *mai*, is occasionally mixed with the colour in calico-printing to thicken it.

This concludes the list of substances used in dyeing which are produced in the North-West Provinces.

SECTION II.—DYE SUBSTANCES USED, BUT NOT PRODUCED IN THE N.-W. P.

A.—OF VEGETABLE ORIGIN.

There are certain substances, vegetable and mineral, which deserve notice as being more or less extensively used by country dyers, though not produced in these provinces. Some of these are dyes; others are merely used in dyeing as accessories.

(1) SAPPAN-WOOD.

(1) Sappan or Brazil-wood. (Ver. Patang or Bakm). The wood of the *Cæslpinia sappan; Nat. Ord. Leguminosæ.*

Sappan-wood is largely imported to Calcutta from Burmah, Siam, and adjacent countries for dyeing purposes, and from Calcutta it is sent to these provinces. Cut into strips and soaked in water, it yields a red dye, the colour of

which is intensified and tinged with violet by the action of an alkali. The cloth is simply dipped in the tincture, taking a red colour which is fleeting, since the dye principle "brazilein" is soluble in water. It is occasionally combined with sulphate of iron and turmeric to produce the shade known as *kalejai* (liver colour), and with indigo to produce purple (*sánsni*). For attaching the dye to cotton tannin and alum are used as mordants ; if wool is to be dyed a mixture of alum and cream of tartar is employed. Sappan-wood is largely used in calico-printing. Its price is about Rs. 12-4-0 per cwt.

(2) SANDAL-WOOD.

(2) Sandal-wood. (Ver. Sandal Surkh). The wood of *Pterocarpus santalinus ; Nat. Ord. Leguminosæ.*

Sandal-wood is imported into these provinces from Calcutta. It is used as a red dye much in the same way as sappan, but not so extensively. The dyeing pigment is less soluble than that of brazil-wood, and the cloth to be dyed is boiled with the wood, not merely soaked in a decoction of it. The price is about Rs. 9-8-0 per cwt.

(3) ASBARG.

(3) Asbarg. (No English name). A yellow dye extracted from the stalks and flowers of a species of *Delphinium*, probably *D. ajacis ; Nat. Ord. Ranunculaceæ.*

The flowers and stalks are imported into these provinces from Kabul and Khorasan *viâ* the Panjáb. A decoction made from them is much used in silk-dyeing, giving the sulphur yellow colour known as *gandhaki*. It is also used in calico-printing. Its price is Rs. 27-5-0 per cwt.

Saffron is imported into these provinces from Káshmir, but only as a rule used as a drug ; for dyeing purposes its high price is prohibitive.

The remaining five foreign vegetable substances are only used as auxiliaries in dyeing, and in many cases it is extremely difficult to discover the *rationale* of their use, since it is a peculiarity of Indian manufactures that processes for which there is good reason are often employed without the reason being known, and men are content to accept from their forefathers whatever was proved beneficial, without troubling themselves as to what the benefit consisted in.

(4) MAINPHAL.

(4) Mainphal. (No English name). The fruit of *Randia dumetorum ; Nat. Ord. Cinchonaceæ.*

Mainphal is imported into these provinces *viâ* Bareilly and Pilibhít, and sells in the market at Rs. 11 to 14 per cwt. for large-sized, and Rs. 4 to 8 per cwt. for small-sized fruits. It is used in calico-printing, it is said, as a colour intensifier.

(5) MULETHI.

(5) Ver. Mulethi. (Liquorice). The wood of *Glycyrrhiza glabra*, imported into these provinces from the Panjáb and sold at about Rs. 16-6-0 per cwt. It is used in calico-printing.

(6) Kulinjan. (No English name). The wood of *Alpinia galanga* which is imported into these provinces from the Panjáb, and sells at about Rs. 4 per cwt. A decoction of it is used in calico-printing along with myrobalan. (6) KULINJAN.

(7) Mochras. (No English name). Two different substances are used in dyeing, both of this name: one consists of small pieces of a dark-brown resinous-looking substance, generally mixed with some fragments of bark; this is said to be the gum of the semal (*Bombax Malabarica*); the other is in largish opaque yellow pieces, curiously convoluted, and is supposed to be an exudation from the areca palm (*Areca catechu*). Both are used in calico-printing. (7) MOCHRAS.

(8) Buznak. (No English name). The flower of the pistachio, imported *viâ* the Panjáb and used in silk-dyeing. (8) BUZNAK.

B.—OF MINERAL ORIGIN.

The chief foreign mineral dyes used in these provinces are anilines, imported from Europe, the use of which seems steadily on the increase, especially amongst the poorer classes. Large dyers in cities like Cawnpore as yet use them but sparingly, and people who can afford to pay the higher price of the vegetable dyes locally produced seem to prefer the latter, since their colours, though at first less brilliant, stand exposure to the heat and sun much better than those of aniline dyes. Still these possess three advantageous qualities: in the first place, by their means cloth can be dyed at an extremely low cost, so small is the quantity required and so trifling is the waste in the operation of dyeing compared with that of vegetable dyes; in the second place, the colour produced by their use is more brilliant, though perhaps less lasting; and thirdly, from the small bulk they occupy, they are very easily carried about by the petty traders, and thus brought within the reach of the poorer classes at the various small country markets. It is difficult to ascertain the extent to which aniline dyes are taking the place of those of vegetable origin, since their manipulation being much simpler than that of the latter, they are much used in private houses, and people by them become independent of the dyer and save in expense accordingly. The professional dyers seldom if ever use them, nor can they be expected to desert the dyes of their forefathers, so long as there is merely a decrease in their profits and they are not actually reduced to the extremities of want and destitution. Aniline red is now even employed in making the red powder, *abír*, used at the Holi time (*vide* page 27), and rice flour dyed red with it is taking the place of the powdered root of the *amahaldi*. The *blue* aniline dye attaches to cloth without a mordant, but its brilliancy is fleeting; the *red*, *purple*, and *green* are mordanted for cotton by alum; the *black* is the most permanent of all the aniline colours, and is mordanted by oxidisation through a salt of copper. (1) ANILINE DYES.

(2) CINNABAR.

(2) Cinnabar (Ver. Shingarf), Sulphide of Mercury, is manufactured in Calcutta (Balfour), and is said to be found native in parts of Central India. It is ground and mixed with water, giving a fresh pink tint (*shingrafi*) to cloth dipped in it. It is used in dyeing more by private people than professional dyers. Its price is about Rs. 140 per cwt.

(3) VERDIGRIS.

(3) Verdigris (Ver. zangar), Sub-acetate of Copper, is imported into these provinces from Lucknow, where it is manufactured. It is occasionally used in calico-printing. Its price is Rs. 2-8-0 per cwt.

(4) BLUE VITRIOL.

(4) Blue Vitriol (Ver. Tutia). Sulphate of Copper. Sulphate of copper is imported into these provinces from the eastern parts of Bengal. It is used with lime to produce a shade of light blue, chiefly, however, in leather-dyeing. Its price is about Rs. 5 per cwt.

(5) MULTANI MITTI.

(5) Ver. Multani mitti. (No English name). A soft drab-coloured kind of fuller's earth imported from the Panjáb and sold at Rs. 2-12-0 per cwt. Its chief use is as a soap for washing the hair and body, but it is also used in dyeing cloth, various shades of buff and brown.

(6) YELLOW ORPIMENT.

(6) Yellow Orpiment (Ver. Hartal) Sulphuret of arsenic, is imported into these provinces from Calcutta, though found in the Kumaun hills (*Economic Mineralogy of N.-W. P. Hills*, page 31.) Its price is Rs. 31-6-0 per cwt. It is used in dyeing a yellow colour.

These are the *dyes* of mineral origin which are imported into these provinces. Three other foreign mineral substances deserve notice as being used in dyeing, the first of which, *alum*, is out of all comparison the most important.

(7) ALUM.

(7) Alum (Ver. Phitkari) is imported into these provinces from Calcutta and sold at Rs. 7 per cwt. It is very much used as a mordant in dyeing, especially for the colours of madder and turmeric. It is seldom, if ever, used with safflower.

(8) BORAX.

(8) Borax (Ver. Sohaga) is imported from Tibet, and used occasionally with turmeric in calico-printing.

(9) MICA.

(9) Mica (Ver. Abrak) powdered fine is sometimes used by dyers, as well as by washermen, to give a sparkle to the cloth, to which the particles adhere.

Recapitulation.

The chief dyes used by the dyers of this country may be then enumerated as follows:—

I.—OF VEGETABLE ORIGIN.

Vegetable dyes.

(*a*) *From the root.*

Al ... } red.
Madder ... }
Turmeric ... yellow.

(*b*) *From the stem.*

Sappan-wood	...	red.
Catechu	...	brown.

(*c*) *From the leaves.*

Indigo	...	blue.

(*d*) *From the flowers.*

Safflower	...	crimson.
Harsinghár	...	yellow.
Tesu	...	
Tún	...	

(*e*) *From the fruit.*

Babúl pods	...	black.
Mango rind	...	yellow.

To these may be added—

(*f*) *From insect formations on the branches.*

Lac	...	red.
Oak-galls	...	*grey.*

Mineral dyes.

II.—OF MINERAL ORIGIN (BESIDES ANILINE DYES).

Sulphate of iron	...	black.
Red ochre (geru)	...	red.
Blue vitriol	...	blue.
Cinnabar	...	pink.
Yellow orpiment	...	orange.
Multani mitti	...	buff.

Most of these dyes may be combined with one another, or rather used in company with one another, for, as noticed before, a compound colour is produced by successive dyeings in each of the component colours, and not by dyeing in a mixture of them. The shades of colour produced depend on the depth to which each of the component colours is dyed.

As regards the permanent or fleeting character of the colours produced, it would appear that indigo, properly fermented, and catechu are the only important vegetable dyes which are permanent, independently of any kind of mordant or accessary to fix the colour to the cloth. Both of these are fixed by oxidisation, and though it is usual in England to oxidise catechu by means of some other substance, yet it would appear that to some extent at all events, like indigo, it can be oxidised from the air. The dull tinges produced by oak-galls and myrobalans are also permanent.

Those dyes which are extracted from roots (*viz.*, *ál*, madder, and turmeric) are all fleeting unless fixed by other substances. In the case of all three a metallic oxide applied in a soluble form is necessary to attach them to the cloth, and this is often assisted in its action and the colour concentrated by the addition of tannin or a vegetable principle akin to it. This may be given by *myrobalans*, *aonla fruit*, *pomegranate fruit rind*, and numerous other substances, of which most are a fruit or some part of a fruit. Thus in *ál*-dyeing (*vide* page 18), the

RECAPITULATION.

cloth is prepared by being dipped in a solution of *alum* and *myrobalans*, the same takes place with madder, while turmeric is said to be fixed by *pomegranate rind* and *alum*. With these dyes (derived from roots) may be classed sappan-wood, which is fixed by the same agents.

As noticed above, indigo, if *properly fermented* or, in other words, changed to "indigo white," gives a colour which is permanent of itself.

Not one of the dyes extracted from *flowers* is permanent or can be made so; the acidulated water occasionally used with them is said to be only of service in assisting the absorption of the colour by the cloth.

With regard to dyes of mineral origin, it is noticeable that two, *sulphate of iron* and *red ochre*, are concentrated by *tannin* like the root dyes mentioned above. Cloth to be dyed black with sulphate of iron is invariably first dipped in tincture of *myrobalans*, *aonla fruit*, *&c.*, and the same is done in the case of red ochre. It is said that with the latter dye alum is occasionally used with beneficial effect.

The principle in both cases seems to be the affinity of tannin for iron. If sulphate of iron be not fixed by myrobalan or some substance like it, its colour is a dirty brown; myrobalan contributes, therefore, to the *making* of black as well as fixing it.

Of the remaining four mineral dyes two, *vitriol* and *yellow orpiment*, are fast; *Multani mitti* and *cinnabar* are only partly so.

The red dye *lac* (which is really of animal origin, though for the sake of convenience grouped among the vegetable dyes) is chiefly used in dyeing woollen cloths, when it gives a permanent colour.

Below are noticed the chief combinations of the various dyes and the shades of colour produced:—

Colour.	Dyes in order of application.	Mordants or accessories.	Character of colour.
Black ...	Ál ... Sulphate of iron ...	Myrobalan ... Alūm.	Fast.
	Safflower ... Sulphate of iron.	Myrobalan ...	Fleeting.
	Sulphate of iron ... Indigo. Safflower.	Myrobalan.	Fleeting: if safflower not used, fast.
	Sulphate of iron ... Red earth ...	Myrobalan and aonla. Alum ...	Fast.
	Babúl pod ... Black earth.	...	Fast.
	Sulphate of iron ...	Myrobalan ... Alum.	Fast.
	Turmeric ...	Pomegranate rind.	

RECAPITULATION.

Colour.	Dyes in order of application	Mordants or accessories.	Character of colour.
Grey	Indigo. Oak-galls	...	Fast.
Lavender	Safflower. Oak-galls	Alum	Fleeting.
Purple	Indigo Safflower.	...	Fast.
Maroon	Safflower Indigo.	...	Fleeting.
Blue	Indigo	...	Fast.
	Vitriol	Lime	Fast.
Green	Indigo	Myrobalan Alum.	Fast.
	Turmeric	Pomegranate rind.	
	Indigo. Tesu Harsinghár.	Acid	Not known.
	Sulphate of iron	Pomegranate rind	Fast.
	Turmeric	Alum.	
	Turmeric Blue vitriol.	...	Fast.
Yellow	Turmeric Harsinghár Tesu.	Lime Acidulated water.	Fleeting.
	Turmeric	Pomegranate rind Alum.	Fast.
	Yellow orpiment. Mustard	Gum	Fast.
Orange	Turmeric	Acidulated water	Fleeting.
	Safflower		Fleeting.
Pink	Cinnabar		Fast.
Red	Safflower Madder	Myrobalan Alum.	Fast.
	Sappan-wood	Myrobalan Alum.	Fast.
	Lac		Fast.
Brown	Sulphate of iron. Catechu	Myrobalan	Fast.
	Lac. Sulphate of iron		Fast.

The dyeing industry of these provinces is divided into two distinct branches, each being followed by a separate class of Musalmáns. First, the

rangrez, whose trade is to dye in plain colours, and the second, the *chípí*, or the calico-printer. Dyers (*rangrez*) generally dye for hire cloth which his customer sends him; on the other hand, the calico-printer (*chípí*) prints his own cloth, which he buys plain and sells when printed. In some instances the calico-printers dye plain colours also, as the *kharua* (coarse red) cloth of Mau Ránipur (*vide* page 18) and the *sálu* (a finer cloth dyed red). The combination of different dyes by which the dyer (*rangrez*) produces his different colours has been noticed under the head of each article. No instance of his encroaching upon the trade of the calico-printer is known, but he produces a kind of spotted cloth, called *chunri*, by a simple method, which at the same time is quite within the bounds of his profession. The process will be described in Part II., among the dyeing manufactures of these provinces.

PART II.

OF CERTAIN SPECIAL FORMS OF DYEING INDUSTRY PRACTISED IN THE N.-W. P.

In this Part will be described four branches of dyeing industry which deserve especial notice—calico-printing, and the dyeing of cotton yarn, silk, and wool.

(1) *General description of the process.*

CALICO-PRINTING. General description.

Calico-printing.—Calico-printing is carried on, more or less, in most of the towns of these provinces, but, with the exception of two or three, in none is the industry so extensive as to be called important, and is often confined to three or four individuals. Farukhabad is the city in which calico-printing is most flourishing, and the following description is taken from information collected there. The prints manufactured are generally of two sorts—one is the coarse native cloth known as *garha*, which when printed is used as a *farash*, a carpet; for the others, the English cloth known as *márkín* (American drill), imported or manufactured at the Cawnpore Mills, or the native fabrics known as *gazi adhota* and *dhoti jora* are generally used; these when printed are known as *chínt*, apparently a Hindustani form of our word *chintz*. This *chínt* is sometimes worn, being favourite material for women's petticoats, or it may be made up into bed-quilts, &c.

The following general description is based on the printing of *chínt*:—

Washing (*dholai*).—The printer makes the cloth over to the washerman, who, if it is English made, simply takes the starch off by washing it in clear water. If the cloth is native made and unwashed, he dips it in a preparation of impure carbonate of soda (*reh*) and some kind of dung (usually sheep's) finely powdered; the water is partly wrung out and the cloth left to lie in this state for a night. In the morning it is again washed in clear water, after being beaten for some time on a flat stone or plank, the native washerman's invariable substitute for hand-rubbing. He then dips the cloth again in the *reh* mixture and again wrings partly dry. A copper vessel nearly full of water is placed on the fire, over the month of which four bamboo sticks are laid so as to form a sort of platform. The cloths are piled on these bamboos round the edge so as to make a kind of circular wall, up the centre of which the steam from the boiling water can pass. This process is known as the *bháti*; it is kept up for about 12 hours, when the cloth is again beaten and washed in clear water. The washing is then complete, but if the cloth be very coarse, the whole process is sometimes gone through twice. The cloth is then sprinkled with water and left in the sun to dry.

CALICO-PRINTING. General description.

Bleaching (*merai*).—The use of chlorine or sulphur as bleaching agents appears to be unknown in this country. Cloth is generally bleached by the washerman or the tanner caste (*chamár*), the printer supplying all the ingredients used except the carbonate of soda (*reh*). Some oil (castor, gingelly, or linseed) is mixed with a certain quantity of *rassi*, making a white emulsion, in which the cloth is dipped and rubbed, being subsequently wrung out, and left for three or four days spread out on grass under cover. After this the cloth is again dipped in the emulsion, to which some powdered sheep's dung has been added. It is again wrung out, exposed in the sun for an hour or so, and again left to dry in the shade for some twenty-four hours. This process is continued for from three to fifteen days, the time of exposure and sunlight being every day increased. The bleaching is considered complete when the cloth is perfectly white after washing. Cloths on which only fleeting colours are to be printed are not generally bleached.

Second washing.—When the bleaching is finished the cloth is dipped in the dung and *reh* preparation, beaten on a stone, and washed. It is allowed to lie spread in the sun for three or four days, water being occasionally sprinkled over it.

Application of myrobalan.—The cloth is returned to the *chípí*, who prepares an infusion of the following substances powdered fine and mixed with water; the quantities given are for 20 pieces of cloth, each about 5½ yards long by 38 inches wide :—

Myrobalans, 1¼ lb.
Fruit of Terminalia bellerica (*Ver.* bahera), 4oz.
Galls of Tamarix articulata (*Ver.* mai farásh), 4oz.
Fruit of Ægle marmelos (*Ver.* bael), 1½lb.
Legumes of Acacia Arabica (*Ver.* babúl singri), 1½lb.

These substances are used for a principle they contain, which is apparently tannin or akin to it. They are all powdered fine, mixed with castor-oil, and divided into five equal parts, into each of which four pieces of cloth are successively dipped. As noticed before (page 48), the action of myrobalans and like substances is twofold : with compounds of iron they form a permanent black colour, while they assist the action of alum as a mordant to the dyes derived from roots or stems, of which there are four—*ál*, madder, turmeric, and sappan wood.

Beating (*Ver. kundi*).—The cloth is spread on a flat block of wood and well beaten with clubs by men, who are thence called *kundigars* (club-men). This would appear to prepare the cloth for taking up the dye.

Printing (*chapái, thatái, or datái*).—The only apparatus required for printing is some wooden dies, into which the proposed pattern has been cut, and an earthen vessel called the *gadia*, on the top of which a light convex bamboo

General description.

framework is fitted. Over this a thick cloth, generally of wool, is stretched, the bamboos being pliable enough to bend easily and allow the cloth to sink to the mouth of the vessel on pressure being applied from above. The cloth to be printed is stretched on a board covered with some 12 layers of cloth, to act as a pad (*parchua*). The manner in which the colour may be applied to the fabric is twofold: either the colour itself is printed on the cloth with the die, or a mordant only is printed, the colour being applied by subsequent boiling. The latter method is generally followed when the dye to be applied is of the root class, such as madder, and contains the principle *alizarine*. As types of the different process may be taken the printing of black patterns by sulphate of iron and the printing of red patterns by madder.

Printing in sulphate of iron.

The *sulphate of iron*, or rather the black-coloured water in which iron and treacle have been soaked for some days, is thickened by the addition of *dhao* gum (*Anogeissus latifolia*), clarified butter (*ghi*), and wheat flour, the compound becoming thick and of the consistence of honey. This is poured into the printing pot (*gadia*); the die is pressed on the framework, sinking it to the sulphate of iron, some of which is absorbed by the blanket, and through it reaches the die. The die is placed firmly on the cloth and given three taps with the hand. The pattern is thus printed in short pieces,

Boiling in *dha* flower.

and when it is finished the cloth is boiled in a decoction of *dha* flowers (*Grislea tomentosa*), which is said to give lustre to the black and take from it any of the brownish tinge which the sulphate of iron gives when not acted on by tannin previously applied. When *dha* flowers cannot be obtained, the cloth is boiled in a decoction of linseed or gingelly oil cake. This clarifying process is called *ugtái*.

Printing in madder.

For madder a mixture is made of the following ingredients in 5 gallons of water: —

Turmeric, 4 oz.
Bark of Symplocos racemosa (lodh), ½lb.
Root of Glycyrrhiza glabra (mulethi), 4 oz.
Alum, 2½lbs.

Cleaning.—As with the sulphate of iron, clarified butter, *dhao* gum, and wheat flour are added to bring the mixture to the proper consistency. The cloth is then stamped with it in the same way as with sulphate of iron, except that a cotton cloth is used over the printing pot instead of a woollen one. The cloth, with the patterns printed on it in a faint yellow colour, is sent to the washerman, who takes them to a stream of running water and lays it on a line stretched between two posts below the surface of water. They are allowed to remain thus for some time till all impurities are removed which might blur the patterns or spoil their clear definition. The cloth is then sent to a *chamár* or tanner, by whom all processes requiring boiling are generally conducted.

CALICO-PRINTING. Different colours used.

He throws some *dha* flowers and 60lbs. of powdered madder into about 160 gallons of water, places it in a chaldron over a fire, and, when raised to the boiling point, the cloth is thrown in. It is boiled for five or six hours, at the end of which the madder has become fixed on to the printed portions of the cloth, making them of a deep-red colour.

Subsequent washing.—Any part of the mordant which may have remained in a soluble condition is removed by another washing with sheep's dung (called *khagárna*) which the cloth is subjected to, whether it has been printed in the first or in the second of the two methods above described, and it is exposed to the action of the sun and air for three or four days.

Application of the ground colour.—This may be done in three ways :—

(1) By painting the dye on to the blank space by the hand;
(2) By dipping the cloth in a dye; or,
(3) By boiling it in it.

In any case the patterns are protected by a paste made of lime and gum, which is put into the printing pot and printed over the patterns. This is technically known as a *resist paste*, and its action may be either mechanical or chemical. If simply a mixture of flour paste and gum is used, the former is the case. Instances of chemical resists are the employment of acids to prevent the mordants becoming insoluble, or of a strong oxidising agent, which, oxidising the white indigo mixture as soon as it meets it, renders it insoluble before it has time to combine with the cloth. If the ground colour is to be blue, the cloth is sent to the dyer, who dyes it with indigo in the method described on page 9. If it is to be dyed red with madder, a tincture of the latter is made in water and rubbed on by hand between the patterns. The alum may be applied with the madder or after it.

Indigo ground.

Madder ground.

Starching (*kaláf*).—The cloth is dipped in a thin paste of rice or wheat flower, or in a solution of babúl gum or in buffalo's milk, and then dried. Cloths which are printed in fleeting colours are starched before being dyed.

Beating (*kundi*).—The cloth is again beaten smooth with clubs while moist, and the process is complete.

(2) *The different colours used and the methods of their application.*

The chief colours used and the methods of their application will now be noticed, print colours being mentioned separately from ground colours.

(*a*) PRINT COLOURS.

(a) Print colours.

The three dyes most generally used for printing colours are sulphate of iron, madder, and *ál;* all three dyes are permanent. European aniline dyes are used to a greater or less extent, but the colours they give are fleeting, as are also those of turmeric, *dhák* flowers, and sappan-wood when employed alone and not fixed by the agency of madder or *ál.*

Different colours used.

The process of printing black in sulphate of iron has been described above: the colour is stamped on the cloth with a dye, and through the affinity of the tannin previously applied a black permanent dye is formed. Occasionally turmeric and alum are added to the sulphate of iron, and a green black colour is produced, known as *kasni*. This is the process followed in printing all dyes except madder and *ál*.

Sulphate of iron.

Kasni.

For *indigo* a mixture is made as follows:—

Shell-lime, 4lbs.
Stone-lime, 10lbs.
Impure carbonate of soda (reh), 15lbs,

are mixed with three gallons of water and strained through grass.

To the solution is added—

Sulphuret of arsenic, 1lb.
Indigo, 1lb.

the mixture being boiled till it assumes the metallic greenish-blue lustre of the peacock's tail. It is then thickened with babúl gum and is ready for printing. The colour is permanent.

Catechu.—2lbs. of catechu are boiled in 3 gallons of water: 1lb. of shell-lime is added, and the mixture allowed to stand for 12 hours. The surface water, which contains the dye, is then taken out, and, after being thickened, is ready for use. The colour is brown and permanent.

Turmeric is prepared for printing by being mixed with 4 gallons of water containing pomegranate rind and alum in the following proportions:—

Turmeric, 5lbs.
Pomegranate rind, 2lbs,
Alum, 1¼lb.

The compound is left to stand for a night, the suface water strained off, and ½lb of indigo added. It is prepared for use by being thickened with gum, clarified butter, and flour in the usual way. The colour is a greenish yellow and is fleeting.

Sappan-wood.—1¼lb. of sappan wood is boiled twice over, each time in 3 gallons of water. The boiling is stopped each time when two-thirds of the water has evaporated, and the residual 2 gallons of tincture are mixed with 1½ quart of buffalo's milk and reboiled with ¾ of alum until half the liquid has evaporated. The residuum is thickened in the usual way. The colour is light red and is fleeting.

Tesu is very often used in printing foliage as a border; 2lbs. of the flowers are boiled in 1¼ quart of water and strained. To the tincture are added lime ¾ and alum ¼, and it is thickened for printing in the usual way. The

CALICO-PRINTING. Different colours used.

Aniline dyes are used for printing by being finely powdered and mixed with water, which is thickened in the usual way to the proper consistency. Various colours are used, most of which are said to be more or less fleeting.

Madder and ál.—The processes followed in printing in madder and *ál* are very similar: in both cases the pattern is previously printed in alum mixed with some turmeric or the red ochre (oxide of iron) known as *geru:* in both cases *dha* flowers are used either with or immediately after the application of the madder or *ál*, and in both cases these dyes are applied to the cloth by its being boiled in them. Red patterns in ochre and alum are often printed after black ones have been printed in sulphate of iron; in this case the cloth is sometimes dipped in tincture of myrobalans between the two printing processes; the ochre serves to define the patterns, which are subsequently dyed red with madder.

Madder is also used to fix a blackish green, a colour produced by borax, sulphate of iron, and *mochras* (resin of the areca palm).

It also adds to the brilliancy of black patterns dyed in sulphate of iron, when they are boiled in it.

The colours given by *ál* and madder are red, and permanent when fixed by alum and tincture of myrobalans.

(*b*) GROUND COLOURS.

(*b*) GROUND COLOURS.

As mentioned before, ground colour may be applied to cloth by rubbing it on with a piece of flannel, by simply dipping the cloth in it, or by boiling the cloth in it. In any case, if the printing has been performed before the dyeing, the patterns are protected by a paste made of lime and gum. Occasionally, especially in the case of the light-blue aniline dye known as *abi*, the ground colour is applied before the patterns are printed, but this appears to be somewhat exceptional. Sometimes, too, the patterns are printed in paste alone, with the effect of leaving them white when the rest of the cloth is dyed.

A great many of the ground colours are fleeting; indeed, it may be broadly stated that, with the exception of *Multani mitti*, no ground colour is perfectly permanent which is merely *rubbed on* to the cloth; and only one dye, fermented indigo, is fast when applied by soaking without the aid of heat. The dyes most commonly used are madder, *ál*, and sappan-wood, each giving a red dye, and being applied by the cloth being boiled in a tincture of it.

Multani mitti.—10lbs. of the earth powdered and mixed with 20 gallons of water. It is rubbed on with a piece of flannel, giving a yellow permanent dye.

Cinnabar is applied in the same way, and gives a pink fleeting dye.

Pomegranate rind is one of the commonest dyes used for ground colour. 3½lbs. of it are well powdered and mixed with 3 gallons of water; the water is then strained, and powdered turmeric, 3½lbs., added to it. It is strained again, and 6oz. of indigo are mixed with it. The mixture is rubbed on to the cloth,

Examples of—

and gives a green fleeting dye, which becomes more or less permanent when alum is used with it.

Asbarg (*Delphinium ajacis*) is used to give a yellow ground colour. 4lbs. of asbarg are boiled in 3 gallons of water till one-fourth has evaporated, when the tincture is strained off: the asbarg is again boiled in another 3 gallons of water till one-third has evaporated, when the tincture is strained off and mixed with the one just made; ½lb. of *lodh* is added, and the dye is rubbed on to the cloth, at first alone, and then in combination with turmeric (3½ lbs.) and alum (1¾ lb). The colour is fleeting.

Tesu, the flower of the dhák tree, is prepared by being rubbed in water and mixed with a little madder, turmeric, and alum. This dye is also applied by being rubbed on. The colour it gives is fleeting.

Arusa.—A decoction of *arusa* leaf (*Adhatoda vasica*) is also occasionally used as giving a yellow colour. It is rubbed or painted on to the cloth.

Sappan-wood, even when the cloth is boiled in it with alum, only gives a fleeting colour. It is used a good deal, but generally before madder, which fixes it. It gives a dull-red colour.

Madder is occasionally used as a ground colour as well as for printing. If alum be applied to the whole cloth as well as to the patterns before it is boiled in madder, the dye will be fixed all over it, the patterns standing out in a darker shade, owing to the turmeric which was used in printing them. If the patterns be then protected by paste and the cloth be dyed in indigo, the ground colour will be of a purple tint, while the patterns remain red.

Ál, like madder, attaches to the whole cloth boiled in it if alum be present. It is then a permanent colour, but gives a fleeting red tint if it is only rubbed on to the cloth.

(3) *Examples of the method of printing certain kinds of fabrics.*

Printed calicoes are used for bed-quilts (*palang-posh*), mattresses (*toshak*), quilted coverlets (*lihâf* or *dogá*), quilted shawls (*fard*), carpets (*jájim*, *farash*), tent materials (shamiana, *chint zarda*), and are also very much worn as petticoats by the women of the lower castes. The places most noted for calico-printing are Farukhabad, Kanauj, and Tirwa, towns in the Farukhabad district. The *chípís* of Mau Ránipur chiefly confine themselves to plain dyeing in *ál*. At these places the cloths most used are English, either imported or made at the Cawnpore Cotton Mills. Either long-cloth or American drill (called by the natives *márkín*) may be used for quilts, coverlets, and mattresses. Although the four towns mentioned above are the chief ones in which prints are manufactured for foreign consumption, yet nearly every town has one or two *chípís* who print in a more or less primitive way and supply the wants of the place they live in.

CALICO-PRINTING.

Examples of—

These latter generally use country-made cloth, which for *chintzes* is generally the kind called *gârha* or *gazi*, according to its breadth; for rough work, *carpets, &c.*, the coarse cloth called *chawka* or *dhoti jora* is generally used.

The following are a few examples of the processes by which chintzes are printed by native manufactures :—

FARUKHABAD CITY.

BUND-UDI CHINT of Farukhabad, used for petticoats, chiefly by village women. *Material*—English long-cloth from the Cawnpore mills, cut up into pieces, each measuring 5½ yards by 38 inches. Twenty such pieces are taken at a time. *Colour*—red (madder) patterns on a red (madder) or purple (madder and indigo) ground.

Processes—(1.) Washed as described in page 51.

(2.) Bleached as in page 52.

(3.) Second time washed as in page 52.

(4.) Myrobalan applied, page 52.

(5.) Beaten smooth, page 52.

(6.) Printed with turmeric in the following way:—The printer first takes 4 oz. of turmeric, grinds it on a stone, and mixes it with 5 gallons of water, to which he adds bark of *Symplocos racemosa* ½ lb., *Glycyryhza glabra*, 4 oz., alum 2½ lbs., clarified butter, 1 oz., wheat flour 1 oz., and a little gum of *Anogeissus latifolia*, the compound being well stirred with the hand becomes of the consistency of honey, when it is strained, and is then fit for printing, which is done as described in page 52. The object of putting clarified butter into the compound is to prevent its becoming frothy.

(7.) The next process is called *pachhârna* or washing the prints. This is done either by the washerman or the *chamár* (tanner), who floats the printed cloths under running water in the way described in page 53.

(8.) Colouring with manjhít. This is done by the *chamár*, who takes 80 pieces of cloth at a time. A cauldron containing about 160 gallons of water is placed on the fire; when the water is a little heated, 1½ lb. of *Grislea tomentosa* flower is thrown into it which gives a thick white colour to the water. Powdered madder roots, 60 lbs., are then added, and the 80 pieces of the printed cloth are then put into the cauldron, two at a time, and well stirred with a stick. A slow fire is kept on for five hours, during two of which the water is continuously stirred. Greater heat is now applied until the red colour of madder adheres to the ground and the printed parts assume a darker hue. The cloths are then taken out, placed on sticks kept ready for the purpose, and when cool sent to be washed.

(9.) Washed in clear water, kept spread out on sand for a night, then dipped in water mixed with sheep's dung, washed again, dried, and returned to the printer.

(10.) Application of resist-paste. A compound formed of lime 10 lbs., gum acacia 2½ lbs., and gum of *Anogeissus latifolia* is now printed over the previous patterns by the same mould in order to protect them from the indigo to come after.

(11.) Dipped in indigo by the dyer (rangrez).

(12.) Washed by washerman as in process No. 7 and resist-paste taken off.

(13.) Starched with solution of gum acacia.

(14.) Beaten smooth. This has become a separate trade, and the class of people practising it are called the *kundigars*. He takes the 80 pieces of the printed cloth, arranges them one above the other, and blows water on them with his mouth. When moist, the cloths are taken up one by one, folded, placed on a smooth block of tamarind wood, and beaten smooth with a wooden club by two persons sitting opposite to each other.

Examples of—

Cost of 20 pieces : cloth Rs. 15, printing Rs. 7, total Rs. 22. Charge Rs. 25. Bought wholesale by merchants and exported chiefly to Cawnpore, Dehli, Karnal, and Amritsar. Much used by middle and poorer classes.

KARILIA, used for petticoats as a holiday dress, especially in marriage festivities. *Material*—English long-cloth cut into pieces of 6 yards each. *Colour*—white prints on blue ground.

Processes—

(1.) Washed.

(2.) Resist-paste, prepared of lime 14 lbs., gum of *Anogeissus latifolia* 7 lbs., pulse (*urd*) flour 3½ lbs., ground and mixed with 6 gallons of water, is then printed over the cloth by a mould. Wheat flour is then sprinkled on the prints when still wet, to make them thicker in order to prevent indigo, in which the cloth is subsequently dipped, penetrating into them.

(3.) Dipped in indigo by the dyer (*rangrez*).

(4.) Washed.

(5.) Beaten smooth.

Cost of 20 pieces : cloth Rs. 16-4-0, printing Rs. 3-7, total Rs. 19-11. Charge stated to be Rs. 20. Used extensively by the lower classes, and exported chiefly to the towns of Agra, Shikohabad, Karnal, Mainpuri, Jaswantnagar, and Etáwah.

CHINT LIHAF, used for making quilts for night covering in the cold season by the rich and the middle classes. *Material*—English long-cloth washed or unwashed, cut into pieces 6 yards long. Twenty such pieces are taken at a time.

Processes—

(1.) Washed. If it is English-washed, the starch is only taken off; otherwise the usual process for cleaning it is followed.

(2.) Bleached. The cloth, after being dipped in the alkaline preparation mentioned at page 52, is kept in a room on grass for a week, after which it is brought out and impure carbonate of soda (*reh*) applied for five days. It is then dipped in two gallons of water in which 1 oz. of natrum is dissolved, wrung out, twisted and kept in a room for the night. From the next morning it is exposed to the sun for seven days, the period of exposure being increased each day. The cloth is then dipped and rubbed well in two quarts of water mixed with two quarts of oil, and then kept in a room for 36 hours. On the third day it is again dipped in a mixture of water and half a pound of natrum and exposed to the sun for a short time. This operation is continued from five to seven days, the exposure to the sun being increased every day. When the cloth sinks into the water and becomes perfectly white by being washed, bleaching is complete.

(3.) Second time washed as in page 52.

(4.) Myrobalan applied.

(5.) Each piece of the cloth cut into two and joined, so that the length of each piece becomes 3 yards and the breadth is doubled.

(6.) Beaten even with a club.

(7.) Printing with black. The colour is prepared by a decoction of 2 oz. of sulphate of iron, 45 grains of alum, 45 grains of *Grislea tomentosa* flower boiled in 1¼ quarts of water, to which is added gum of *Anogeissus latifolia*, 2 oz., clarified butter 6 drams, and wheat flour 6 drams. The printing is performed in the ordinary way.

(8.) Printing outline of patterns with red-earth (geru) 1 oz., rubbed on a stone with sweet oil, 1 oz., alum 6 oz., gum of *Anogeissus latifolia* 4 oz., mixed together in a quart of water.

(9.) Washed in stream water.

(10.) Boiled with 1½ lb. of madder and 8 oz. of *Grislea tomentosa* flower.

(11.) Myrobalan again applied.

(12.) Printed with a compound of turmeric, &c., as in *bánd-udi*.

(13.) Printing green formed by a mixture of four parts of the turmeric compound with one part of the black colour used in process (7). The green colour used here is also prepared by

CALICO-PRINTING.

Examples of—

a combination of the following substances :—extractareca (*mochras*) 90 grains, borax 40 grains, sulphate of iron 10 drams, alum 12 drams. iron powder 6 drams, flower of *Althæa rosea* (*gulkhera*) 13 drams, flower of *gulpah*, 6 drams, powdered and steeped for six hours in 1¼ quarts of water. Before printing the surface water is gently poured out and gum of *Anogeissus latifolia* 4 oz, clerified butter 6 drams, and wheat flower 6 drams, added to the residue, which forms the green colour required.

(14.) Washed in stream water.

(15.) After two or three days, 60 pieces of the printed cloth are taken and boiled with 50 lbs. of madder and 5 lbs. of *Grislea tomentosa* flower.

(16.) Washed. The washerman applies sheep's dung to the cloth, washes it in clear water, spreads it on sand to the sun, and sprinkles water, the first day on one side, and the second day on the other. On the evening of the second day he again applies sheep's dung, and for the next two days he sprinkles water as before. In this way sheep's dung is applied ten times and water sprinkled for 20 days. An alkaline preparation composed of impure carbonate of soda (*reh*) 5 lbs., sheep's dung 82 lbs., and 2 quarts of soap-water saved from the bleaching process is then applied to the cloth.

After two days the cloth is washed in clear water and spread on sand, the first day on one side and the next day on the other. When dry it is returned to the printer.

(17.) The printer then exposes the cloth to the sun for 12 days, by which any red that may have adhered to the unprinted part of the cloth is bleached off.

(18.) The cloth is then again sent to the washerman, who dips it in a mixture of soap 4oz., and horse dung ½lb., washes it the next morning, and after drying returns it to the printer.

(19.) Printing blue. A mixture is made of stone lime 10lbs. shell-lime 4lbs., impure carbonate of soda 15lbs, and water 3 gallons, to which, after being strained, are added yellow arsenic 1lb. and country indigo 1lb., after which the whole is boiled until it assumes the shining blue colour of peacock's neck. Before printing gum acacia 2lbs. is added to the compound.

(19.) Washed in stream water.

(20) Application of resist-paste, shell-lime 6lbs. dissolved in water and kept at rest for some time. The surface water is then gently drawn off and the sediment well strained. Soap 1lb. and gum of *Anogeissus latifolia* and gum acacia 16lbs. are then dissolved in it. The compound is then strained and left alone for six months, after which it is fit for use; for, if used at once, it is said that the strong lime injures the cloth, discolours the red, and proves too tenacious to be taken off easily. The lime coating is put over the red patterns in order to protect them from the application of ground colour which is to follow. A line of this resist-paste is drawn as a boundary between the ground and the borders, which are dyed differently.

(21.) Application of ground-colour. This is done by rubbing on the cloth a small piece of blanket wetted with the prepared colour. A piece of the long-cloth is wetted with the prepared colour, and then (being held at the four corners) has the colour rubbed in by hand. The following colours are generally applied on the field :—

Pink (gulábs), madder 2½lbs. and *Symploces racemosa* ½lb. mixed together in 4 gallons of water, strained, and applied to the cloth. After the mixture has once been rubbed, 1½lbs. of alum is dissolved in it and again rubbed as before.

Red (surkh), prepared by mixing madder 6lbs. and alum 1½lbs. in 6 gallons of water.

Green (sabz), pomegranate rind powder 3½ lbs. mixed with 3 gallons of water and strained, to which is then added 3½lbs. of ground turmeric and 6oz. of indigo rubbed on a stone. The compound is then rubbed on the cloth, first time alone, and the second time alum 2lbs. and mango acid 1lb dissolved in it. The cloth is then dried in the shade. In the rainy season the colour is not satisfactorily produced owing to the frequent absence of the sun.

Dark green (sabz dhâni), prepared by mixing ground turmeric 3½lbs., indigo 6oz., and alum 2lbs

Examples of—

Purple (ṭáktái), madder 2½lbs. and indigo 1oz. mixed in 3 gallons of water, or madder 4lbs., indigo ½oz, mixed in 3 gallons of water. The latter mixture forms the colour known in vernacular as *koplei* and is twice applied, 1½lbs of alum being dissolved in it before the second application.

Violet (baigani), madder 3lbs. and aniline violet powder dissolved in 3 gallons of water.

Yellowish, *Delphinium ajacis* 4lbs. boiled in 3 gallons of water. When one-fourth of the water has evaporated the decoction is taken down and strained. The refuse left behind after straining is again boiled in 3 gallons of water and taken down and strained when one third of the water has evaporated. The two decoctions are then mixed together, twice strained, and ½lb. of *Symplocos racemosa* added to it. It is then applied to the cloth twice, turmeric 3½lbs., and alum 1½lbs being mixed in it before the second application.

Straw yellow (sandali), *Butea frondosa* flower 3½lbs. steeped in 5 gallons of water and rubbed well with the hand every morning and evening for four days. When the infusion becomes dark yellow it is put in a tub and the flowers rubbed well with the feet. It is then strained and madder ¾lb. and turmeric 2lbs. mixed with it. The mixture is applied twice to the cloth, alum ½lbs. being added in the last time.

Orange (nárangi), infusion of *Butea frondosa* flower 5lbs. made as above, to which is added madder 3lbs. The mixture is then applied to the cloth and dried in the sun. Some turmeric is then added to the liquid and the cloth dyed a second time with it and dried in the shade. More turmeric and alum 1½lb., borax 4 oz., are then added, and the cloth dyed a third time with it and dried in the sun.

Blue (jastái), country indigo 1½oz. rubbed in water and applied to the cloth.

Sky colour (ásmáni), aniline blue 2oz. dissolved in water.

Water blue (ábi), country indigo 1oz. dissolved in water.

The quantity of dyes given above is sufficient for dyeing 20 pieces of cloth. The colours produced by substances other than madder are injured by exposure to the sun, and hence these are dried in the shade.

(22.) After the ground is thus dyed, the cloths are made over to the tanner (chamár), who washes it in stream water and takes off the resist-paste.

(23.) Clubbed smooth.

(24.) Leaf-printing. Turmeric 5lbs. and pomegranate rind 2lbs. mixed in 4 gallons of water and strained twice. Alum 1½lb. is then added to it and the mixture left at rest for a night. In the morning the surface water is gently poured out, and gum of *Anogeissus latifolia* 1½lbs. and indigo ½lb. added to the sediment, with which the leaves of the patterns are printed. The cloth is then dried in the shade.

(25.) Decorating the pattern flowers and the borders with yellow. *Butea frondosa* flower 2lbs. boiled in 1½ quarts of water, to which is added shell-lime ¾lb., alum ½lb., and some gum of *Anogeissus latifolia*. The compound, which is of yellow colour, is used in decorating the flowers and the borders of the cloth. The cloth is then dried and the manufacture is complete.

The ground of the lihâf is sometimes of one colour and sometimes of four or many colours. The red and black are always fast, turmeric partly fast, and the rest fleeting. Cost of manufacturing 20 pieces is from Rs. 32 to Rs. 47, *i.e.*, cloth Rs. 25 to Rs. 30, printing Rs. 7 to Rs. 17. Charge Rs.4 0 to Rs. 55. It is exported to Pánipat, Bareilly, Cawnpore, Mirzapur, Patna, Lahore, Amritsar, and Karnál, and thence distributed to other places. Five per cent. commission is allowed to purchasers of more than 20 pieces measuring 3 to 3½ yards long by 2 to 2½ yards wide each.

The above examples will give a fair idea of the rude way in which chintzes are printed in these provinces. The Farukhabad and the Lucknow manufac-

CALICO-PRINTING.

Examples of—

tures have an extensive sale and are sent to all parts of India. The dyeing of plain colours practised by calico-printers are almost exclusively confined to the manufacture of sálu and kháruá—fine and coarse red cloths. The latter is described in page 18.

Sálu is dyed in the following way :—*Material*—English cloth, 20 pieces measuring 4 yards by 1 yard each, taken at a time. Used for turbans, borders of female coats and female dress.

Processes—

(1.) Washed.

(2.) Bleached with castor-oil 1 gallon, impure carbonate of soda 5lbs., and sheep's dung 1lb., mixed in 20 gallons of water. For eight days the cloth is rubbed well in the mixture, after which washed and returned to the printer.

(3.) *Terminalia chebula* 2½lbs. applied.

(4.) Clubbed smooth.

(5.) Fifty pieces of the cloth now taken, which is boiled with *Morinda citrifolia* 75lbs. and *Grislea tomentosa* flower 4lbs.

(6.) Washed.

(7.) Starched with gum *Acacia Aralica*.

(8.) Beaten smooth.

Cost of 20 pieces : cloth Rs. 12-8-0, printing Rs. 3-12-0, total Rs. 16-4-0. Charge Rs. 17 to Rs. 18. The above description for the sálu manufacture at the Orai town in Jalaun district. It is chiefly sent to the Marhatta country, where it is worn by the females.

One other fabric remains to be noticed, the spotted cloth called *chunri* made by the dyers in plain colours (rangrez). This is manufactured in the following way :—

Cloth to be dyed is first of all washed, and the places on which spots are to be made are marked out with red earth. The spots are produced by isolating these places from the dye in which the cloth is dipped, and this is done by tying them up in knots, a process requiring considerable ingenuity, generally done by females. In this way not only can white spots be produced on a coloured field, but spots of one colour on a field of another. The whole is, for instance, first dyed yellow ; the knots are then, tied and it is then dyed red. This will give yellow spots on a red ground. Instead of spots lines are often made, and in the spots themselves there is a great variety, since they may be of any shape and any size. The borders are often dyed in different colours to that of the spots or field, which gives the cloth a very picturesque appearance. The *chunri* is worn by women only ; the place where it is chiefly manufactured is Muttra, and large quantities are sold at the July festivals of that sacred city in honour of the birthday of its patron god, Krishna. The principal dyes used in colouring *chunri* are ál, madder, safflower, and sappan-wood.

The following is a list of the principal printed fabrics manufactured in the different towns of the North-Western Provinces. The districts are arranged in the order of their importance in regard to the chintz manufacture:—

List of principal printed fabrics manufactured in the North-Western Provinces.

Name of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing	Length and breadth of each piece.	Cost and charge of 20 pieces.	Whether exported or locally consumed.
Farukhabad town, Farukhabad district.	Búnd-udi ...	Described in detail.			Yards.	Rs. a. p.	
	Búnd surkh...	The manufacture of this cloth is complete with process No. 8 of the above. In other the respects the same.				Cost ... 21 7 0 Charge ... 25 0 0	Exported.
	Karilia.	Described in detail.					
	Liháf ...	Ditto.					
	Fard ...	Long-cloth	As day covering in the cold weather.	Same as *lihdf* ...	3 × 1½	Cost ... 29 0 0 Charge ... 30 0 0	Exported.
	Chint zardá ...	Country coarse cloth (garhá)	For tents ...	Sulphate of iron, yellow earth, (Multáni mitti), turmeric, catechu and Butea frondosa. Colour fast.	8 yards × 12½ inches.	Cost ... 25 3 0 Charge ... 26 4 0	Tents manufactured at Farukhabad and then exported.
Kanauj town, Farukhabad district.	Chint kandi...	English cloth.	For female dress by Márwáris.	Red earth, Symplocos racemosa, turmeric, madder, and indigo. Colour fast.	4 × 1	Cost ... 18 0 0 Charge ... 20 0 0	Exported to Cawnpore.
	Chint bútedár,	Ditto ...	For shirts and coats.	Red earth, madder, pomegranate rind, aniline blue, indigo, turmeric, Terminalia chebula, sulphate of iron, and catechu. Colour fast.	5 × 1	Cost ... 22 8 0 Charge ... 25 0 0 to 30 0 0	Ditto.
	Palang-posh...	Ditto ...	For covering of bed.	Sulphate of iron, red earth, madder, Symplocos racemosa, turmeric, aniline blue, Butea frondosa, pomegranate rind, and catechu.	3 × 2	Cost ... 36 8 0 Charge ... 40 0 0 to 45 0 0	Exported to Cawnpore, from which distributed to all parts of the country.
	Liháf ...	Ditto ...	For quilts ...	Ditto ditto ...	3 × 2	Ditto ...	Ditto.
	Toshak ...	Ditto ...	Mattresses ...	Ditto ditto ...	2½ × 1½ double.	Cost ... 40 0 0 Charge ... 42 8 0 to 45 0 0	Ditto.
	Fard pokhta (fine).	Ditto ...	Day covering in cold weather.	Sulphate of iron, red earth, Symplocos racemosa, turmeric, madder, pomegranate rind, aniline blue, and indigo. Colour fast.	3 × 1½	Cost ... 24 0 0 Charge ... 26 0 0 to 30 0 0	Ditto.

List of principal printed fabrics manufactured in the North-Western Provinces—(continued)

Nume of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing.	Length and breadth of each piece.	Cost and charge of 20 pieces.	Whether exported or locally consumed.
					Yards.	Rs. a. p.	
	Fard pokhta (coarse).	Country cloth, (garhá.)	Day covering in cold weather.	Red earth, Symplocos racemosa, sulphate of iron, Morinda citrifolia, turmeric, pomegranate rind, aniline blue. Colour fast.	3 × 1½	Cost ... 20 10 0 Charge ... 25 0 0	Exported to Cawnpore, from which distributed to all parts of the country.
	Liháf (fleeting).	English cloth.	Quilts ...	Sappan-wood, indigo, Butea frondosa, turmeric, sulphate of iron, pomegranate rind, aniline blue. Partly fast.	2¾ × 1½	Cost ... 14 4 0 Charge ... 16 0 0	Ditto.
	Palang-posh (fleeting).	Ditto ...	Bed covering ...	Red earth, sulphate of iron, turmeric, pomegranate rind, aniline blue. Partly fast.	3 × 2	Cost ... 6 11 0 Charge ... 8 0 0	Ditto.
	Toshak (fleeting).	English cloth.	Mattresses ...	Same as before ...	2¾ × 1½ (double.)	...	As before.
	Fard rangdár (fleeting).	Ditto ...	Winter day covering.	Sulphate of iron, pomegranate rind, Terminalia chebula, aniline blue, verdigris, aniline green and yellow, sappan-wood. Colour fleeting.	2¾ × 1½	Cost ... 15 0 0 Charge ... 16 0 0	Sent to Cawnpore, from whence distributed to other places.
	Fard bútedár (fleeting).	Ditto ...	...	Pomegranate rind, turmeric, indigo. Partly fast.	2¾ × 1½	Cost ... 14 6 0	Exported to Cawnpore
Tirwa Thatia town, Farukhabad district.	Fard pákki ...	Country cloth (garhá),	Winter day covering.	Red earth, Morinda citrifolia, pomegranate rind, turmeric, sulphate of iron. Colour fast.	3 × 1½	Cost ... 23 8 0 Charge ... 25 0 0	Exported to Cawnpore and Farukhabad.
	Fard káchi ...	English cloth.	Ditto ..	Terminalia chebula, sappan-wood. Colour fast.	3 × 1½	Cost ... 16 11 0 Charge ... 18 0 0	Exported to Fyzabad.
	Chint momi ...	Country cloth (dhol).	Female dress ...	Red earth, indigo, pomegranate rind. Colour fast.	8 × 1	Cost ... 25 0 0 Charge ... 26 4 0	Sent to Nánpára; used by villagers.
Bishangarh town, Farukhabad district.	Chint nimser...	Ditto ..	Ditto ...	Red earth, turmeric, pathání lodh, indigo, pomegranate, Adhatoda vasica. Colour permanent.	8 × 1	Cost ... 25 10 0 Charge ... 27 8 0	Locally consumed.

	Dogá ...	Country (cloth, gárha).	Winter night covering.	Red earth, turmeric, pathání lodh, Butea frondosa, aniline blue, sulphate of iron, Terminalia chebula. Colour permanent.	2¾ × 1½ (double).	Cost ... 24 4 0 Charge ... 28 8 0	Ditto.
Mau Ránipur town, Jhánsi district.	Khárua (a red cloth).	Country cloth, (ikri).	Mattresses ...	Terminalia chebula, Morinda citrifolia, sappan-wood. Colour fast.	7 × 1	Cost ... 28 0 0 Charge ... 29 8 0	Exported to almost all parts of India.
	Nathni and chapeta.	Ditto ...	Female dress ...	Red earth, Morinda citrifolia, indigo. Colour fast.	...	Cost ... 33 12 0 to 48 12 0 Charge ... 35 0 0 to 50 0 0	Exported to Háthras, whence distributed to other places.
	Chint (agrewar)	Ditto ...	Ditto ...	Country sulphate of iron, red earth, Morinda citrifolia, indigo. Colour fast.	,,	Cost ... 31 6 0 to 41 6 0 Charge ... 35 0 0 to 50 0 0	Ditto ditto.
Orai town, Jalaun district.	Golbúti	Country cloth (dhoti jora).	Skirts and female dresses.	Red earth, country sulphate of iron.	6½ × 4	Cost ... 17 8 0 Charge ... 18 8 0	Exported to Kálpi, Jalaun, Kúnch, Samthar, Jhánsi, Auraiya, Sikandra, Etáwah, Bithúr.
	Shamiáná ...	Ditto ...	Tents or awnings used at festivals	Ditto ditto ...	6¼ × 3¾	Cost ... 21 4 0 Charge ... 22 8 0	Ditto ditto.
	Toshak ...	Ditto ...	Mattresses ...	Ditto ditto ...	2 × ½ (double).	Cost ... 21 4 0 Charge ... 22 0 0 to 23 0 0	Ditto ditto.
	Jázim ...	Ditto ...	Sitting upon by rich and middle classes.	Red earth, sulphate of iron ..	6½ × 2¼	Cost ... 52 8 0 Charge ... 22 0 0 to 23 0 0	
	Dhoti jora zanáná.	Markín cloth.	Female dress ...	Ditto ditto ...	8½ × 1	Cost ... 32 8 0 Charge ... 33 0 0 to 35 0 0	Sent chiefly to Bengal.
	Angochha ...	Country cloth.	Towel ...	Ditto ditto ...	2½ × ⅝	Cost ... 7 8 0 Charge ... 8 8 0	Sent towards Bengal.
	Chint dodhára lahengáwár.	Ditto ...	Female dress ...	Ditto ditto ...	6½ × ¾	Cost ... 17 8 0 Charge ... 19 0 0	Sent towards the eastern districts.
	Pátal or sárni,	Markín cloth.	Ditto ...	Ditto ditto ...	7 × 1	Cost ... 21 4 0 Charge ... 22 8 0 to 23 0 0	Exported to the Marhatta country.
	Sálu (a red cloth).	Ditto ...	Ditto ...	Ditto ditto ...	4 × 1	Cost ... 16 4 0 Charge ... 17 8 0	Ditto ditto.

List of principal printed fabrics manufactured in the North-Western Provinces—(continued).

Name of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing.	Length and breadth of each piece.	Cost and charge of 20 pieces.	Whether exported or locally consumed.
					Yards.	Rs. a. p.	
Sayyidnagar town.	Chint zimaradi.	Country cloth (ikri).	Female dress for poorer classes.	Red earth, black earth, indigo. Colour fast.	7 × $\frac{7}{8}$	Cost ... 35 0 0 Charge ... 40 0 0	Exported to Háthras and Sháhjahánpur.
Káshipur town, Tarái district.	Chint (Thákurdwárá).	Country cloth (gárha.)	Mattresses by rich and middle classes.	Red earth turmeric, Morinda citrifolia, Butea frondosa, pomegranate rind, indigo, sulphate of iron, Terminalia chebula. Colour fast.	10 × $\frac{1\,1}{1\,6}$	Cost ... 23 12 0 Charge ... 25 0 0	Exported to Moradabad, Sháhjahánpur, Cawnpore, Farukhabad, Bareilly, Háthras, &c.
	Toshak ...	Ditto ...	Ditto ...	Ditto ditto ...	2½ × 1½	Cost ... 23 12 0 Charge ... 25 8 0	Ditto ditto.
	Liháf ...	Ditto ...	Making quilts ...	Ditto ditto ...	3 × 1½	Cost ... 17 0 0 Charge ... 19 8 0	Ditto ditto.
Aligarh town, Aligarh district.	Nándna, and chint Kishangarh.	Country cloth.	Female dresses by poorer classes.	Red earth, indigo, sulphate of iron, Terminalia chebula, pomegranate rind, turmeric. Colour fast.	12 × $\frac{1\,1}{1\,6}$	Cost ... 23 0 0 Charge ... 25 0 0	Locally consumed.
	Liháf ...	English markín cloth.	Quilts ...	Country sulphate of iron, sappanwood, turmeric, Terminalia chebula, indigo, aniline blue. Colour fleeting.	3 × ½	Cost ... 21 0 0 Charge ... 23 0 0	Exported to Háthras.
	Fard khám ...	Ditto ...	Day covering by rich and middle classes.	Ditto ditto ...	3 × ½	Ditto ...	Ditto ditto.
Atrauli town, Aligarh district.	Chint zarda ...	Country cloth (ghazi).	Female dress by poorer classes.	Red earth. Colour fast ...	16 × ½	Cost ... 26 4 0 Charge ... 28 0 0 to 30 0 0	Sold at Aligarh.
	Chint nili ...	Country cloth.	Female dress by baniyas of rich and middle classes.	Sulphate of iron, red earth, indigo, Butea frondosa, pomegranate rind. Colour fast.	12 × $\frac{1\,1}{1\,6}$	Cost ... 31 4 0 Charge ... 34 0 0	Exported to Panjáb.
	Chint nasírjangi.	Ditto ...	Female dress and skirts.	Sulphate of iron, red earth. Colour fast.	12 × $\frac{1\,1}{1\,6}$	Cost ... 27 8 0 Charge ... 28 0 0	Locally consumed.

	Chint Jalálábadi.	Ditto ...	Ditto ...	Ditto ditto ...	12 × 1 1/16	Ditto ...			Ditto.
	Razái ...	Ditto ...	Winter day covering.	Country sulphate of iron, red earth. Colour fast.	3 × 1⅜	Cost ...	14	0	0 Ditto.
						Charge ...	15	8	0
Agra town, Agra district.	Chint kanti ...	Ditto ...	Shirts by poorer classes.	Country sulphate of iron, indigo. Colour fast.	7½ × ⅞	Cost ...	20	0	0 Exported to Háthras.
						Charge ...	21	0	0
	Nándua safed zamin and nándua zard zamin.	Country coarse cloth.	Female dress for poorer classes.	Country sulphate of iron, red earth, indigo, turmeric. For colouring *nándua safed zamin* the last two colours are not used. Colour fast.	7½ × ⅞	Cost ...	20	0	0 Locally consumed.
						Charge ...	21	0	0
Muttra town, Muttra district.	Chunar of Rájamandi.	English markín cloth.	Ditto ...	Indigo. Colour fast ...	6½ × 1 yards.	Cost ...	24	4	0 Exported to Háthras.
	Chint zarda and chint safeda.	Country cloth (ghazi).	Ditto ...	Red earth, sappan-wood. Colour partly fast.	10 × ½	Cost ...	19	8	0 Ditto.
						Charge ...	20	8	0
Fyzabad town,	Nathni and chapeta.	Same as nathni and chapeta mentioned before.							
Muttra and Brindaban towns, Muttra district.	Dopatta ...	Englishand markín long-cloth.	Turban (for men), hood (for women).	Red earth, country sulphate of iron, turmeric, indigo. Colour permanent.	3 × 1	Cost ...	12	8	0 Exported to all parts of India.
						to	15	0	0
						Charge ...	15	0	0
						to	20	0	0
	Chint ...	Country and English-cloth.	Female dress and shirts.	Ditto ditto ...	6 × 1	Cost ...	23	12	0 Exported to Háthras.
						Charge ...	25	0	0
						to	27	8	0
	Dhoti jora ...	Ditto ...	Lower garments,	Ditto ditto ...	9 × 1¼	Cost ...	21	4	0 Ditto.
						Charge ...	22	8	0
	Angochha ...	Ditto ...	Towel ...	Ditto ditto ...	2 × 1	Cost ...	2	0	0 Ditto.
Mainpuri town, Mainpuri district.	Khára ...	Country cloth (dhoti jora).	Bridal dress ...	Red earth, Butea frondosa. Colour partly fast.	7½ × ⅞	Cost ...	20	0	0 Exported to many places.
						Charge ...	25	0	0
						to	30	0	0
	Doga ...	Country cloth.	...	Red earth, Butea frondosa, pomegranate rind, turmeric, aniline blue, sappan-wood, Terminalia chebula. Colour fast.	3 × 1½	Cost ...	30	8	0 Locally consumed.
						Charge ...	34	8	0
	Jázim sakarpera.	Ditto ...	Carpet ...	Country sulphate of iron, red earth. Colour fast.	7½ × 1	Cost ...	61	9	0 Ditto.
						Charge ...	71	0	0
	Jázim jhárdár,	Ditto ...	Ditto ...	Country sulphate of iron, yellow earth. Colour fast.	...	Ditto ...			Ditto.

CALICO-PRINTING.
Examples of—

List of principal printed fabrics manufactured in the North-Western Provinces—(continued.)

Name of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing.	Length and breadth of each piece.	Cost and charge of 20 pieces.	Whether exported or locally consumed.
					Yards.	Rs. a. p.	
	Toshak ...	Country cloth.	Mattresses by Rajputs.	Country sulphate of iron, red earth. Colour permanent.	$2\frac{3}{4} \times 1\frac{1}{2}$ (double).	Cost ... 19 5 0 Charge ... 22 8 0	Locally consumed.
	Chint safeda...	Ditto ...	Winter covering,	Red earth, country sulphate of iron. Colour fast.	$7\frac{1}{2} \times \frac{7}{8}$	Cost ... 18 13 0 Charge ... 20 0 0	Ditto.
Soraon town, Allahabad district.	Dogá ...	Country cloth (garha).	Quilts for cold weather,	Country sulphate of iron, red earth, turmeric and indigo, Terminalia chebula. Colour fast.	3 × 1½ (double).	Cost ... 28 10 0 Charge ... 28 8 0	Ditto.
	Fard ...	Ditto ...	Winter day covering.	Ditto ditto ...	3 × 1½	Cost ... 12 13 0 Charge ... 14 4 0	Ditto.
Phulpur town, Allahabad district.	Dogá ...	Country cloth and English markín.	Mattresses ...	Country sulphate of iron, red earth. Colour fast.	$2\frac{3}{4} \times 1\frac{1}{2}$	Cost ... 23 12 0 Charge ... 25 0 0	Exported to Bengal.
	Toshak ...	Ditto ...	Quilts ...	Ditto ditto ...	$2\frac{3}{4} \times 1\frac{1}{4}$	Cost ... 16 0 0	Ditto.
	Kacha khárua,	English and country cloth.	Pillows, mattresses.	Sappan-wood. Colour fleeting ...	6 × ¾	Cost of English cloth khárua is 22 6 0 Cost of country cloth ... 13 2 0 Charge ... 14 6 0	Exported to Allahabad city.
Manda village, pargana Khairagarh, Allahabad district.	Razái ...	English cloth.	Winter day covering.	Country sulphate of iron, turmeric, Alpinia gulanga, Glycyrhyza glabra, Butea frondosa, indigo. Colour fast.	$2\frac{3}{4} \times 1\frac{3}{4}$	Cost ... 21 0 0 Charge ... 22 4 0	Exported to Calcutta and North-Western Bengal.
	Toshak ...	Ditto ...	Mattresses ...	Ditto ditto ...	2 × 1½	Ditto ...	Ditto.
	Chhír ...	Ditto ...	Female dress ...	Ditto ditto ...	5½ × 1	Ditto ...	Ditto.
	Gungásága ...	Ditto ...	Ditto ...	Ditto ditto. ...	5½ × 1	Ditto ...	Ditto.
Allahabad city, Allahabad district.	Farásh ...	Country cloth (dhoti).	Carpets ...	Country sulphate of iron, red earth.	7 × 1¼	Not sold, but manufactured by order.	Locally consumed.

CALICO-PRINTING.

Examples of—

Fatehpur town, Fatehpur district.	Líháf ...	Country cloth.	Quilts ...	Country sulphate of iron, red earth. Colour fast.	2½ × 1¼	Cost ... 18 12 0 Charge ... 22 8 0	Exported to Bengal.
	Toshak ...	Ditto ...	Mattresses ...	Ditto ditto ...	1¾ × 1¼ (double.)	Cost ... 21 4 0 Charge ... 23 0 0	Ditto.
	Chint ...	Ditto ...	Female dress and shirts for men.	Ditto ditto ...	10 × ¾	Cost ... 40 0 0 Charge ... 45 0 0 to 50 0 0	Ditto.
Kalianpur town, Fatehpur district.	Jázim ...	Ditto ...	Carpets ...	Ditto ditto ...	...	Not sold.	
	Toshak ...	Ditto ...	Mattresses ...	Ditto ditto ...	2 × 1¼ (double.)	Cost ... 19 0 0 Charge ... 22 8 0	
	Shámiána ...	Ditto ..	Tents and awnings at festivals.	Ditto ditto ...	...	Not sold.	
	Palang-posh...	English markín.	Bed covering ...	Ditto ditto ...	3 × 2	Cost ... 28 12 0 Charge ... 35 0 0 to 40 0 0	Exported to Cawnpore and Lucknow.
	Sálu ...	English markin. cloth.	Female dress ...	Morinda citrifolia. Colour fleeting,	7 long.	Cost ... 24 0 0 Charge ... 27 0 0	Sent to Cawnpore, from which exported to other places.
Cawnpore town, Cawnpore district.	Chint astúr, derah.	Country cloth (garha and dhoti jora).	Lining of tents...	Yellow earth, sulphate of iron, catechue. Colour fast.	6 × 1	Cost ... 22 8 0 Charge ... 25 0 0	
	Farásh ...	Ditto ...	Carpet ...	Ditto ditto ...	6 × 1	Not sold; manufactured by order.	
	Sálu ...	English markín cloth.	Worn at marriages by Hindus and used by females as a sheet.	Morinda citrifolia. Colour fast ...	40 × 1	Cost ...127 2 0 Charge ...151 7 0 to 163 0 0	
Chándpur town, Bijnor district.	Chint gulábi...	Country cloth (gárha).	Female dresses, shirts, &c.	Morinda citrifolia, sappan-wood. Colour fast.	5 × ⅞	Cost ... 14 5 0	Sent to Háthras and Najibabad, from which distributed.
	Chint nili ...	Ditto ..	Ditto ...	Red earth, turmeric. Colour fast,	5 × ⅞	Ditto ...	
	Chint kasisi ...	Ditto ...	Ditto ...	Country sulphate of iron. Colour fast	5 × ⅞	Ditto ...	
	Chint pistái ...	Ditto ...	Ditto ...	Indigo, pomegranate rind, yellow earth, Terminalia bellerica, Terminalia chebula. Colour fast	5 × ⅞	Ditto ...	

List of principal printed fabrics manufactured in the North-Western Provinces—(continued.)

Name of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing.	Length and breadth of each piece.	Cost and charge of 20 pieces.	Whether exported or locally consumed.
					Yards.	Rs. a. p.	
	Chint safeda khám.	Country cloth (garha).	Female dress, shirts, &c.	Sappan-wood, pomegranate rind, turmeric, indigo, country sulphate of iron. Colour fleeting	5 × 1⅛	Cost Rs. 14 5 0	
	Chint mungia,	Ditto ...	Female dress ...	Indigo, pomegranate rind, turmeric, sappan-wood, country sulphate of iron. Colour partly fast.	5 × 1⅛	Cost ... 14 5 0	
	Chint dáne dár,	Country cloth.	Ditto ...	Red earth, turmeric, Morinda citrifolia, yellow earth, pomegranate rind. Terminalia chebula. Colour fast.	5 × 1⅛	Cost ... 15 0 0 Charge ... 18 0 0	
Najíbabad town, Bijnor district.	Chint nakal dres.	Country cloth (gárha).	...	Red earth, turmeric ...	5 × 1⅛	Ditto.	
	Chint sabz ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint zard ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint safed ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint udi ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint níli ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint gulábi ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Chint surkh ...	Ditto ...	...	Ditto ditto ...	5 × 1⅛	Ditto.	
	Angochha ...	Ditto ...	...	Ditto ditto ...	...	Ditto.	
	Dhoti ...	Ditto ...	...	Ditto ditto ...	...	Ditto.	
Sháhjahánpur town, Sháhjahánpur district.	Toshak ...	Ditto ...	Mattresses ...	Red earth, country sulphate of iron, pomegranate rind, turmeric, indigo.	2 × 1½ (double).	Cost ... 25 5 0 Charge ... 30 0 0	
	Lihaf ...	Ditto ...	Quilts ...	Ditto ditto ...	2½ × 1⅝	Cost ... 16 14 0 Charge ... 20 0 0	
	Fard surkh ...	Ditto ...	Cold-weather day covering.	Ditto ditto ...	2½ × ¼	Cost ... 16 6 0 Charge ... 20 0 0	Exported to Oudh, Pilibhít, and Dhaingháat.
	Fard siáh ...	Ditto ...	Ditto ...	Ditto ditto ...	2½ × 1⅝	Cost ... 16 14 0 Charge ... 20 8 0	
	Chint Agrái ...	Ditto ...	Female dress ...	Ditto ditto ...	10 × 1	Cost ... 27 0 0	

							Charge	... 30 0 0 to 32 0 0		
	Jázim ...	Ditto ...	Carpet ...	Ditto ditto ...	10 × 2	Cost	... 73 2 0			
						Charge	... 80 0 0			
Mirzapur town, Mirzapur district.	Liháf or doga.	English long-cloth and country gárha.	Quilts ...	Red earth, country sulphate of iron, turmeric, indigo, Butea frondosa. Colour partly fast.	2¾ × 1½ (double).	Cost	... 21 8 0			
						Charge	... 23 0 0			
	Chint ...	Ditto ...	Shirts ...	Ditto ditto ...	5½ × 1	Cost	... 22 3 0			
						Charge	... 25 0 0		Exported to Bengal.	
	Gangáságar ...	Ditto ...	Ditto ...	Ditto ditto ...	5½ × 1	Cost	... 22 3 0			
						Charge	... 25 0 0			
	Dhoti ...	Ditto ...	Wearing ...	Ditto ditto ...	5½ × 1	Cost	... 12 3 0 to 22 3 0			
						Charge	... 15 0 0 to 25 0 0			
Muzaffarnagar town, Muzaffarnagar district.	Chint jangal rang surkh	Country cloth (gárha).	Female dress ...	Red earth, country sulphate of iron, pomegranate rind, turmeric, indigo. Colour fast.	10 × 1 1/16	Cost	... 28 12 0			
						Charge	... 31 8 0			
	Chint jangal udi.	Ditto ...	Ditto ...	Ditto ditto ...	10 × 1 1/16	Ditto ...			Locally consumed.	
	Chint Chamaria	Ditto ...	Ditto ...	Ditto ditto ...	10 × 1 1/16	Cost	... 27 8 0			
						Charge	... 29 8 0			
Deoband town, Sabáranpur district.	Jázim ...	Ditto ...	Carpets ...	Country sulphate of iron, red earth, pomegranate rind, turmeric, indigo. Colour fast	24 × 1 1/16	Cost	... 40 8 0		Exported to Meerut, Saháranpur, and Ambála.	
						Charge	... 45 0 0 to 50 0 0			
Khúrja town, Bulandshahr district.	Chint Jalalbádi.	Country cloth.	Female dress ...	Red earth, sappan-wood. Colour fast.	8 × 1 5/16	Cost	... 17 10 0			
						Charge	... 20 15 0			
	Chint dodot ...	Ditto ...	Ditto ...	Red earth, indigo, Terminalia chebula, country sulphate of iron, pomegranate rind, turmeric. Colour fast.	8 × 1 5/16	Cost	... 21 6 0		Locally consumed.	
						Charge	... 23 0 0 to 25 0 0			
	Súraj páki ...	Ditto ...	As sheet by women.	Morinda citrifolia. Colour fast ...	6 × 1 3/16	Cost	... 15 14 0		Exported to Jodhpur.	
						Charge	... 17 8 0			
	Párehelungi (khárnu).	Ditto ...	Petti coats ...	Sappan-wood. Colour fleeting ...	8 × 1	Cost	... 22 14 0		Sent to all places.	
						Charge	... 25 8 0			
Bágpat town, Meerut district.	Dolái ...	Country cloth (gárha).	Winter day covering.	Country sulphate of iron, yellow earth, red earth, sappan-wood, pomegranate rind, turmeric, Morinda citrifolia. Colour fast.	3 × 3½	Cost	... 25 0 0			
						Charge	... 27 8 0		Locally consumed.	

Examples of—

CALICO-PRINTING.

List of principal printed fabrics manufactured in the North-Western Provinces—(concluded.)

Name of place where manufactured.	Name of fabric.	Material.	Used for	Principal colours used for printing	Length and breadth of each piece.	Cost and charge of 10 pieces.	Whether exported or locally consumed.
					Yards.	Rs. a. p.	
	Toshak ...	Country cloth (garha).	Mattresses ...	Country sulphate of iron iron, yellow earth, red earth, sappan-wood, pomegranate rind, turmeric, Morinda citrifolia. Colour fast.	2¼ × 1½ (double).	Cost ... 29 0 0 Charge ... 30 0 0 to 32 0 0	
	Chint ...	...	Female dresses ...	Ditto ditto ...	20 × ⅞	Cost ... 30 0 0 Charge ... 32 0 0 to 35 0 0	
	Lihâf ...	Ditto ...	Quilts ...	Ditto ditto ...	3½ × 1½	Cost ... 30 0 0 Charge ... 32 0 0 to 35 0 0	
	Jázim ...	Ditto ...	Sitting upon ...	Ditto ditto ...	...	Cost ... 107 0 0 Charge ... 119 0 0 to 125 0 0	
Bareilly town, Bareilly district.	Toshak ...	Ditto ...	Mattresses ...	Sappan-wood, Terminalia chebula, pomegranate rind, aniline blue, country sulphate of iron, turmeric. Colour fleeting.	2½ × 1¼ (double).	Cost ... 17 0 0 Charge ... 20 0 0	Locally consumed.
	Lihâf ...	Ditto ...	Quilts ...	Ditto ditto ...	3 × 1½	Ditto.	
	Fard ...	Country cloth.	Winter day covering.	Ditto ditto ...	3 × 1½	Ditto.	
	Chint ...	Ditto ...	Female dress and shirts.	Ditto ditto ...	16 × ⅝	Cost ... 19 8 0 Charge ... 21 8 0	
	Razâi pokhtá ...	Ditto ...	A day covering ...	Country sulphate of iron, red earth, madder, lodh. Colour fast.	3 × 1½	Cost ... 20 4 0 Charge ... 25 8 0	
Etáwah town, Etáwah district.	Chint chapti and chint nathni.	Country cloth (ikri).	Female dress ...	Red earth, pomegranate rind, indigo. Colour fast.	6½ × 1	Cost ... 26 2 0 Charge ... 29 8 0	
Bánda town, Bánda district.	Toshak ...	Country cloth (garha), ghazi, and dhoti jora).	Mattresses ...	Red earth, Morinda citrifolia, turmeric, indigo, country sulphate of iron, Terminalia chebula. Colour fast.	2 × 1½ (double).	Cost ... 27 8 9 Charge ... 30 0 0	
	Lihâf ...	Ditto ...	Quilts ...	Ditto ditto ...	2¾ × 1½	Cost ... 18 12 0 Charge ... 20 0 0	Exported to Sayyidnagar and Kalpi in Jalaun and Kishangurh in Fatehpur.
	Chint butedár,	Ditto ...	Shirts and drawers.	Ditto ditto ...	7 × 1½	Ditto.	

	Jázím ...	Ditto ...	Carpets ...	Ditto	ditto ...	...	Cost	... 27 0 0		
							Charge	... 30 0 0		
	Doga ...	Ditto ...	Mattresses ...	Ditto	ditto ...	$2\frac{1}{4} \times 1\frac{1}{2}$ (double.)	Cost	... 31 4 0		
							Charge	... 32 8 0		
Pailani town, Bánda district.	Jánmáz ...	Country cloth (dhoti jora, ghazi or garha.)	Used for sitting upon by Musalmans in time of prayer.	Red earth, country sulphate of iron, indigo. Golour fast.		$2\frac{1}{4} \times \frac{15}{16}$	Cost	... 14 11 0		
							Charge	... 15 8 0		
	Toshak ...	Ditto ...	Mattresses ...	Ditto	ditto ...	$2\frac{1}{4} \times \frac{1}{2}$ (double.)	Cost	... 29 11 0		
							Charge	... 31 8 0		
	Jázim ...	Ditto ...	Carpets ...	Ditto	ditto ...	$7\frac{1}{2} \times 2\frac{5}{8}$	Cost	... 88 12 0	Exported to Hamírpur and Cawnpore.	
							Charge	... 90 0 0 to 92 0 0		
	Palang-posh ...	Ditto ...	Counterpanes ...	Ditto	ditto ...	3 × 2	Cost	... 18 12 0		
							Charge	... 20 8 0		
	Dastarkhán ...	Ditto ...	Sitting upon in time of taking meals.	Ditto	ditto ...	$1\frac{3}{4} \times 1\frac{3}{4}$	Cost	... 13 12 0		
							Charge	... 15 8 0		
	Shámiáná ...	Ditto ...	Awnings in festivals.	Ditto	ditto ...	...	...			
	Farash ...	Ditto ...	Carpets ...	Ditto	ditto ...	...	...			
Jaunpur city, Jaunpur district.	Doga ...	Country cloth (dhoti).	Quilts ...	Red earth, country sulphate of iron, Terminalia chebula, Butea frondosa, turmeric. Colour partly fast.		$3\frac{1}{2} \times 2$	Cost	... 21 9 0	Exported to Bengal.	
							Charge	... 25 0 0 to 30 0 0		
Benares city, Benares district.	Dhoti ...	English markín cloth.	Worn by women,	Red earth, country sulphate of iron. Colour fast.		5 × 1	Cost	... 28 12 0	Locally consumed.	
							Charge	... 30 0 0		
	Chint ...	Ditto ...	Shirts ...	Ditto	ditto ...	5 × 1	Ditto			
	Chunri or spotted cloth.	Country cloth or English markín cloth.	Worn by women,	Red earth, safflower, Morinda citrifolia, sappan-wood.		3 × $1\frac{1}{2}$	Cost	... 20 8 0		
	Dorokha, or cloth of which the two sides are dyed with different colours.									

(B)—DYEING OF COTTON YARN.

(B)—DYEING OF COTTON YARN.

The elaborate and variously coloured patterns on the finer descriptions of native fabrics are produced more effectually by weaving the cloth of dyed yarn than by dyeing the cloth when ready woven. The hand-weavers of these provinces mostly belong to two large classes, the Korís or Kolis (Hindús) and the Juláhas (Muhammadans). There are other weaving castes, such as the Parsutias, who generally engage themselves in some peculiar manufacture not engrossed by either Korís or Juláhas, but their numbers are insignificant compared with those of the two latter classes.

As a rule the Korís confine themselves to weaving white cloth, and it is the Juláhas by whom most of the weaving in colours is done. These latter differ from the Korís in being townspeople, and are but seldom found in agricultural villages. They suit their manufactures to the market, and the fabrics they turn out are finer than those of the Korís, as well as more generally woven with coloured than with white thread.

The yarn used may either be bought by the weavers ready dyed or be dyed by them; it may be European, country, machine-spun (at the Cawnpore and other mills) or country hand-spun. The use of the latter is diminishing where either of the two former are procurable.

As a rule yarn is bought white by weavers and sent by them to dyers; occasionally weavers dye it themselves, in indigo especially, the process for which is much easier than for most other colours.

The commonest colours yarn is dyed are red (with *ál*), blue (with indigo), and green (with indigo, turmeric, and pomegranate rind).

The processes followed are almost exactly similar to those in dyeing cotton cloth described in Part I.

The following is the method of dyeing with *ál* practised in Mau Ránipur:—

The yarn is soaked in water and beaten out with a wooden club on a flat stone. It is then bleached by being soaked in a mixture of castor-oil (1 gallon), carbonate of soda (5 to 7 lbs.), and water (40 gallons). It is then wrung out and left to dry for some twelve hours, when it is again soaked in the same mixture, to which 2½lbs. of powdered sheep's dung have been added. It is then dried in the sun. This process is continued for some twelve days, when the bleaching is complete. Yarn is bleached by the washerman caste, not by the weaver or dyer, and costs 12 annas per 40lbs.

From 30 to 50 lbs. of powdered *ál* is mixed with a solution of 5 to 7lbs. of alum in water. The yarn is twice steeped and rubbed in the mixture, and allowed to dry for four days after each steeping. It is finally boiled in the mixture, which completes the process. The steeping of the yarn in the mixture is called *bor*.

(B)—DYEING OF COTTON YARN.

The red colour thus produced is fast. If the red is to be fleeting and of a coarser quality, the yarn is not bleached, being merely dipped in an infusion of myrobalan and then in the *dl* mixture. It is finally soaked in a decoction of sappan wood.

The processes for dyeing with indigo and turmeric differ in no important particular from those described in Part I.

(C)—SILK-DYEING.

(C)—SILK-DYEING.

Benares is the only place in the North-West Provinces where there is any considerable silk-weaving industry. Raw silk is brought here from the Panjáb, from Bombay, from Murshidabad, Maldah, and other towns in Eastern Bengal, and from Calcutta. That from the Panjáb and Bombay is known as *sangal*, while that from Bengal is called *máng*. The former of these sorts is strong and thick, and on this account is preferred for weaving ; it sells at from Rs. 5 to 6 per pound. The latter sort is finer and softer, and is about a rupee per pound less valuable than the *sangal*.

After buying the raw silk, the weaver (Juláha) carefully separates it into three portions, containing respectively the thinner, medium, and thicker threads. The two latter alone are used for weaving : the first is sold to the jeweller and used for binding jewellery. The silk is then made over to the *Lahera* or professional silk-dyer.

Cleaning.

The actual dyeing of the silk is always preceded by a cleaning process of some kind or other, the agents used being carbonate of soda and lime. Some 20lbs. of the former are placed on the ground and shaped into a mound with a cup-shaped hollow in the centre, which is filled by about 12lbs. of lime. The heap is left exposed to the air for some three hours, when the lime and soda are well mixed and formed into a ball. Two large earthen pots are then placed one above the other, the upper one having a small hole in the bottom. This hole is stopped up and the alkaline ball placed in this upper jar, which is then filled up with water and allowed to stand for a night. In the morning the hole is opened and the water (impregnated with the alkali) allowed to filter through into the lower jar. The solid residuum is thrown away and the solution refiltered, to remove all particles of solid matter. The silk, which has been previously soaked in water, is now boiled in this solution together with a little sweet-oil. The silk is next cooled and dipped in a solution of alum in water, when the cleaning process is completed by its being simply washed in clear water.

If the colour which the silk is to be dyed be aniline or fleeting, the cleaning process is not so elaborate as that described above, carbonate of soda and soap (instead of lime) being generally used.

(C)—SILK-DYEING.

The permanent colours in which silk is generally dyed are :—

Red	with	lac or cochineal.
Orange	„	kamila.
Yellow	„	asbarg.
Green	„	asbarg indigo.
Blue	„	indigo.

Silk, being an animal fibre, assimilates dye particles in some cases far more easily than cotton does, or rather silk and cotton, being of radically different natures, appear to be governed by different principles in the assimilation of colour. Hence it follows that dyes which are fleeting on cotton may be fast on silk, and *vice versâ*.

Lac.

Dyeing with lac.—Some stick-lac is cleaned of wood, dirt, etc., which usually reduces its weight by one half. It is then ground in a hand-mill and some alkali mixed and well rubbed with it. The mixture is trodden out by the feet in five separate quantities of water successively, to each of which it parts with its red colouring matter in decreasing amount. The five infusions are then mixed together, some *lodh* bark (*Symplocos racemosa*) added to it, and the whole boiled till it emits the smell of boiling milk. The decoction is then divided into three parts, in each of which the silk is successively boiled till the red colour has attached itself. Three acids are used to clear the colour—infusion of tamarind leaf, milk acid (*dahi*), and infusion of mango leaf. These are used after the first, second, and third boiling respectively, being mixed with the lac infusion and not applied separately. Alum is also used with the mango acid. The silk is dried in the shade, well washed in clear water, and again dried, when the process is complete. The lac dye extracted from 82lbs. (a maund) of stick-lac will dye 6lbs of silk. Sometimes the silk is steeped in vinegar for four or five days after the application of the lac.

Cochineal.

Dyeing with cochineal.—Half a pound of cochineal is steeped in a quart of water, in which ½lb. of buznak has been mixed. The cochineal is well rubbed with the hand and the water strained off. This is done four times, the same quantity of cochineal and buznak being rubbed in four separate quantities of water, giving four infusions of different strength. These are mixed together and boiled. One-fourth of the decoction is kept separate, and the silk to be dyed is boiled in the remaining three-fourths. When the red colour has attached to the silk, the other fourth is added, and the silk allowed to steep in the mixture for 48 hours. It is then dried in the shade, washed, and again dried, when the process is complete.

The silk is prepared for the reception of the dye by being previously soaked in alum water.

Dyeing with kamila (*Rottleria tinctoria*).—The silk is soaked in an infusion obtained by boiling the fruit dust in a weak solution of alum in water, and takes a beautiful golden colour known as *sonhaila*.

Kamila.

Dyeing with asbarg (*Delphinium ajacis*).—The silk is steeped in a decoction obtained by boiling 3lbs. of *asbarg* in 5 gallons of water.

Asbarg.

Dyeing with indigo.—The same process is followed as in cotton-dyeing.

Indigo.

All the above are fast colours. Aniline blues and pinks are occasionally used, but the colours they give are said to be fleeting.

The cost of dyeing 1lb. of silk is said to be as follows:—

	Rs. a. p.	Rs. a. p.
For red	... 2 2 0	
For pink (light red)	... 1 2 0	to 1 6 0
For yellow	... 0 13 0	to 1 2 0

(D)—WOOL-DYEING.

Wool-dyeing is not extensively practised in the North-West Provinces, being in most places confined to wool intended to be used for carpet manufactured in the jails. The following is an account of the methods of wool-dyeing followed in the city of Cawnpore.

Woollen cloth is dyed with native dye in six colours, *viz.*, red, black, brown, blue, yellow, and green. Other colours are produced with European aniline dyes, but since in every case the mode of application is the same, one dye (purple) alone will be noticed as a specimen of the class.

Dyeing red with lac.—This is the most important colour produced, and the following mode of its application is peculiar to woollen cloth. The cloth is first of all soaked for two hours in lime water, in order, so it is said, to relax the hairs and make them readier to receive the dye. It is then well washed. The dyeing infusion is prepared by pounding up stick-lac and placing it, mixed with some alkali, on a cloth through which water is allowed to strain slowly, dropping into a pan beneath. Into the infusion thus obtained wheat flower is thrown to make it ferment, which it does in three days. The cloth is then soaked in it for three days, taking a bright-red colour. The permanence of the colour is tested by washing, and if the result is satisfactory, the process is completed by boiling the cloth in a mixture of *tezab*, lime-juice, and water.

Dyeing red with lac.

(D)—WOOL-DYEING.

In dyeing red with cochineal almost the same process is followed, and the peculiarity in dyeing wool with an animal red (*i. e.*, lac or cochineal) appears to be the fermentation of the dye infusion and subsequent application of *tezáb*. This latter is a distillation from saltpetre, sal-ammoniac, sulphate of iron, and alum in the following proportions :—

Saltpetre	8 parts.
Sulphate of iron	8 „
Sal-ammoniac	2 „
Alum	2 „

These are mixed in an earthen jar, used as retort and placed over a fire, the distillation being conducted much in the same way as that of country spirits. The vapour is conducted down a tube into a second jar, the condensation being effected in the tube, which is cooled by being wrapped in wet rags.

The *tezáb* is mixed with some lemon-juice, and the dyed cloth is boiled in it for about half an hour.

Dyeing brown.

Brown.—The cloth is soaked in an infusion of myrobalans, obtained by crushing them and slowly filtering water through them. An ounce of myrobalan is sufficient for 1lb. of wool. The cloth is next plunged into another vessel containing a weak solution of sulphate of iron in water, and the brown tint is finally given it by a mixture of yellow earth (Multani mitti) and water, in which it is left to soak till the proper tint has been acquired.

Dyeing black.

Black.—The process is exactly the same as that in dyeing brown, except that the sulphate of iron solution is very much stronger and no yellow earth is used.

Dyeing blue.

Blue.—The following ingredients are thrown into a vat mixed with some water and left to ferment :—

Indigo cake	8 parts.
Carbonate of soda	8 „
Lime	4 „
Coarse sugar	1 „

The cloth is well washed, and while yet wet plunged into the fermented mixture, which gives it a blue colour. The *shade* of blue depends on the number of times the dipping (and subsequent drying) is repeated. One will be enough for a pale indigo blue, but for dark blue-black very many dips are necessary.

Dyeing yellow.

Yellow.—This colour may be produced by turmeric, *harsinghár* flowers, or *tesu* (*dhák* flowers) ; in any case it is fleeting. If turmeric is used, the roots are well ground up and mixed with a paste with water. This is thrown into boiling water together with the cloth to be dyed by it. The *harsinghár* flowers are boiled in the same manner with the cloth. The yellow dye is extracted from *dhák* flowers by boiling, and the cloth is dipped in the decoction.

Dyeing green.

Green may be produced by first of all dyeing the cloth blue with indigo and then dipping it into a boiling decoction of turmeric.

These are the colours generally produced by native dyeing substances. The use of aniline dyes seems to be increasing, especially for certain shades of colour, which, if native materials be used, can only be produced by dyeing the cloth separately in two distinct dyes. Thus, *purple* can only be dyed by first using indigo and then safflower; but the application of aniline purple is extremely simple. The proper quantity of the aniline dye is thrown into boiling water, in which the cloth is plunged and moved about. In a short time the application of the dye is complete.

Dyeing aniline purple.

The word *cloth* has been used throughout, but for carpet-making the wool is dyed before manufacture. The country blanket stuff known as *lui* is dyed after being woven.

PART III.

LEATHER TANNING AND DYEING.

LEATHER TANNING AND DYEING.

Before describing the various methods employed in these provinces for tanning and dyeing leather, some account will be given of the different substances which are used in the process. Many of these have already been desunder the heading *Dyes* in Part I, and for these mere mention will be sufficient.

(1) THE DIFFERENT TANNING AGENTS IN USE IN THE NORTH-WEST PROVINCES.

Substances used in the leather industries of these provinces may be conveniently grouped into three classes :—

(1) Those which have for their object the cleaning, curing, and so-called "raising" of the skin, so as to prepare it for the reception of the tanning agent.

(2) Those which contain tannin.

(3) Those which yield dyes used in colouring leather.

In the first class eight substances deserve notice—salt, saltpetre, *rassi*, *sajji*, sal-ammoniac, the juice of the *mádár*, and flour.

(1) *Substances used in preparatory processes.*

Salt (Chloride of sodium.)—The chief kinds of salt used in these provinces are the Panjáb rock salt (*Lahori*) from the Mayo and other mines, the *balambha* salt of Bhartpur, the *sámbar* from the lake of that name, the *salambha* from the salt-pans of Farukhnagar in the Gurgaon district, and the *dindwana* from Jodhpur.

Salt is imported from Europe *viâ* Calcutta, from the salt manufactories on the coasts of the Bengal and Bombay Presidencies, and in very small quantities from Tibet.

These kinds of salt are all edible and are too valuable to be much used in curing, for which an impure saline compound called *khári* is employed, which is imported into these provinces in large quantities from the Gurgaon district, and is also procured from Bengal and from the North-West Provinces themselves. *Khari* contains a large percentage of Glauber's salt, and, though occasionally used to adulterate eating salt, is not an article of food itself. It is largely used in solution to cure and to take the hair off fresh hides.

Sal-ammoniac, saltpetre, *rassi*, *sajji*, and lime have all been described in Part I.

The milky juice of the Madar or ak *(Calotropis gigantea ; Nat. Ord.) Asclepiadaceæ.*

Description.—Shrub, 6-10 feet ; leaves stem clasping, decussate, oblong-ovate, wedge-shaped, bearded on the upper side at the base, smooth on the upper surface, clothed with woolly down on the under side ; segments of corolla reflexed, with revolute edges; stamineous corona 5-leaved,

shorter than the gynostegium; leaflets keel-formed, circinately recurved at the base, incurved and subtridentate at the apex; umbels sometimes compound, surrounded by involucral scales: follicles ventricose, smooth; seeds comose; flowers rose-colour and purple mixed (Drury).

This plant is found in waste places all over the provinces. Its juice is much used in curing the skins of sheep, goats, and deer, especially when it is intended to dye them in fancy colours. The juice is mixed with *bájra* flour (*Penicillaria spicata*, the small millet) and made into a paste, in which the skin is kept for several days before the red lac dye is applied. Occasionally lime-water is applied to the skin before the mádár-juice is used.

(2) *Tanning Agents*—(*a*) *Derived from bark.*

The substances containing *tannin* are of course all of vegetable origin and are derived from the bark, leaves, or fruits of trees.

The Babul or *kíkar* tree has already been described in Part I. Its bark (often called *kas*) is the commonest and most effective tanning agent used in the North-West Provinces. The tree is ready for barking when eight or ten years old. It is cut down from the roots and must be barked at once, while the sap is green; in drying, the inner side of the bark must not be exposed to the sun. As a rule the tree is first of all bought for its timber by the *talwála* or wood merchant, who sells the bark to the tanners. The Cawnpore Government Saddle and Harness Factory uses from 1,000 to 1,200 tons of babúl bark annually.

BABUL.

Babúl seed pods (mentioned as giving a black dye in Part I.) are used for tanning in the villages of the Cawnpore district, and when nothing better is obtainable its *leaves* are employed as a makeshift.

The gum yielded by the babúl tree has been noticed in Part I. Its wood is exceedingly tough, and is especially valuable for carriage and cart wheels; large quantities of it are used annually for this in the Government Post Office Workshops at Aligarh. Besides *tanning* a skin, babúl bark *dyes* it a buff colour.

The bark of the Amaltas *(Cathartocarpus fistula); Nat. Ord. Leguminosæ.*

AMALTAS.

Description.—Tree, middling size, with usually smooth bark; leaflets about 5 pairs, broadly ovate, obtuse or retuse, glabrous: petioles without glands; racemes terminal long, lax, drooping; flowers on long pedicels; legumes cylindric, pendulous, glabrous, smooth, dark-brown, nearly two feet in length: cells numerous, each containing 1 smooth, oval, shining seed, immersed in black pulp; flowers bright yellow, fragrant (Drury).

The bark of this tree is used as a tanning agent, but not to any great extent. Experiments have been tried with it in the Cawnpore Government Factory, and its properties were proved to be very valuable. The quantity procurable was, however, so small that the experiment was not gone on with.

TANNING AGENTS.

The following table shows the exports of amaltás bark from the North-West Provinces forests during the years 1874-75 and 1875-76 :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Najíbabad	36½	31	18¼	18
Rehar	3	2	3	2
Garhwál	1½	1	41	28
Kumaun	34½	56	120¾	196

It is said that the gelatinous contents of the long legumes contain tannin.

SAL.

The bark of the Sal *(Shorea robusta); Nat. Ord. Dipteraceæ.*

Description.—Tree, 100-150 feet ; calyx 5 sepalled, afterwards enlarging into long wings ; petals 5, twisted in the bud, rather silky outside ; leaves cordate-oblong, entire, on short petioles ; calyx pubescent as well as the branches of the panicles ; panicles terminal and axillary ; ovary 3-celled ; cells 2-seeded ; seeds single ; flowers yellow (Drury).

The *sál* tree is well known for its valuable timber, which forms a most important export from the Nepal forests into these provinces.

The bark is said to contain a large amount of tannin. Experiments were made in the Government factory, but were not satisfactory, since the bark obtained was from the trunk instead of the smaller branches, and was therefore too woody. It had also been damaged by rain before it was put to the test.

DHAK.

The bark of the Dhak tree *(Butea frondosa)*, described in Part I., contains excellent tannin, but is little used in the North-West Provinces, where babúl is so plentiful. In the Central Provinces it is in general use for tanning purposes.

LODH.

Lodh bark *(Symplocos racemosa)*, (*vide* page 33), is a valuable tanning agent, but is chiefly used in combination with other substances, since the quantity obtainable is very small.

KAIPHAL.

The bark of the Kaiphal *(Myrica sapida); Nat. Ord. Myricaceæ.*

Description.—A moderate sized evergreen dioicous tree; the current year's branchlets tomentose or pubescent; leaves with a faint pleasant aromatic smell when rubbed or broken, alternate, lanceolate or oblanceolate, narrowed into a short petiole, those on older trees 3-5 inches long, entire, coriaceous, on the under side pale or rust coloured with numerous black resinous dots; petiole and midrib pubescent; main lateral nerves anastomosing by prominent intramarginal and reticulate veins ; leaves on young plants and shoots 5-8 inches long, membranous, with large and sharp serratures and more numerous, prominent main lateral nerves ; male catkins cylindric ¼ inch long, sessile, in lax, axillary drooping racemes, as long as leaf or shorter; female flowers in slender axillary spikes, red ; fruit a sessile ovoid drupe,

several on axillary peduncles, ¾ inch long, tuberculate, pubescent while young, glabrous when ripe, with scanty reddish pulp, which is composed of cylindric or clavate fleshy hairs filled with red juice mixed with fine dry hairs or fibres; nut rugose, pitted (Brandis). TANNING AGENTS.

The bark of the *kaiphal* is best known in these provinces as being a remedy for rheumatism. It is also occasionally employed as a tanning agent in fancy leather work.

The following table shows the exports of *kaiphal* bark from the North-West Provinces forests in the years 1874-75 and 1875-76 :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Najíbabad	36½	62	22	45
Garhwál	44	90	47	96
Kumaun	682½	1,560	235	562
Jaunsár	23½	48	...	...

The bark of the Ber (*Zizyphus jujuba*); *Nat. Ord. Rhamnaceæ.* BER.

Description.—Small tree, 16 feet; stipulary prickles short, in pairs, or solitary, often wanting, especially on the young branches: leaves elliptical or oblong, sometimes coarsely toothed at the apex, serrulated acutish or obtuse or slightly cordate at the base, upper side glabrous, under side as well as young branches and petioles covered with dense tawny tomentum, cymes sessile or very shortly peduncled; ovary 2-celled; styles 2, united to the middle; drupe spherical, yellow when ripe; nut rugose, 2-celled; flowers greenish yellow (Drury).

Ber bark is occasionally used in tanning leather.

In connection with tanning agents derived from the bark of trees may be mentioned

Katha, the inspissated juice of the *Acacia catechu* (*vide* Part I.) KATHA.

It contains a considerable amount of tannin, but the quality is poor and it is too intimately mixed with colouring matters to be of much utility. Its price is about Rs. 15 per maund of 82 lbs.

(*b*) *Derived from leaves.*

The leaves used in tanning are those of the babúl, mango, mahúa, dha, and guava.

Babul leaves have been already noticed.

Leaves of the Mango (*Mangifera Indica*); *Nat. Ord Anacardiaceæ.* MANGO.

Description—Tree; leaves alternate, lanceolate, acuminated, glabrous; calyx 5 cleft; petals 5; panicles terminal, much branched, pubescent, crest.; drupes obliquely-oblong or somewhat reniform; seed solitary; flowers small, greenish yellowish (Drury).

TANNING AGENTS.

A yellow dye can be extracted from the leaves and bark of this well-known fruit tree, although as yet no information has been received of this having been used for dyeing purposes. The leaves, however, are used in tanning, especially by the poorer classes in Oudh. A decoction of dried slices of the unripe fruit is strongly acid, and together with an infusion of tamarind leaves is used in clearing and fixing the colours in dyeing both cloth and leather.

MAHUA.

Leaves of the Mahua *(Bassia latifolia); Nat. Ord. Sapotaceæ.*

Description.—Tree, 40 feet; leaves alternate, oblong or elliptic, crowded about the extremities of the branches, smooth above, somewhat whitish below; stamens 20-30 within the gibbous tube of the corolla, on short filaments; corolla thick, fleshy, with a more than 8-lobed limb; lobes cordate; sepals 4; pedicels drooping, terminal; flowers white, with a tinge of green and cream colour, numerous, crowded from the extremities of the branchlets, peduncled, and bent with the mouth of the flowers directly to the ground; berry size of a small apple, 1-4 seeded (Drury).

The mahúa tree is found in greatest profusion in the districts of the Allahabad and Benares divisions. From its flowers a spirit is extracted, and they are used for this purpose in the Government distilleries of those districts in which the tree abounds, instead of the coarse molasses, from which spirit is distilled in the districts of the Meerut division. The seeds yield an oil of some value, and are also an article of food for the poorer classes. The leaves are occasionally used in tanning by people who cannot afford the expense of anything more effective.

DHA.

Leaves of the Dha *(Grislea tomentosa)*, (*vide* Part I), are much used in tanning in the Bundelkhand districts, in which, with the bark of the *ghunt* tree, they take the place of the babúl bark so universally employed in the Doáb.

GUAVA.

Leaves of the Guava *(Psidium guava); Nat Ord. Myrtaceæ.*

Description.—A small tree or large shrub, young branches pubescent; leaves oblong or elliptic oblong, 4-6 in ches long, on very short petioles, pubescent beneath, nearly glabrous above, with 15-20 pairs of prominent intramarginal veins; peduncles axillary, 1-1½ inch long with 1-3 flowers. Free part of calyx ovoid in bud, larger than the ovoid ovary, bursting into irregular lobes; petals ½ inch diameter or more; fruit globose or obovoid, inside red-white or yellowish (Brandis).

Guava leaves are, like those of the mango and mahúa, occasionally used in tanning by the poorer classes.

AONLA.

Leaves of the Aonla (*Emblica officinalis*), (*vide* Part I). The leaves and (occasionally) bark of the *aonla* are used in tanning. In 1875-76, 128 cwt. of leaves were exported from the Gorakhpur forests.

The remaining tanning substances are derived from fruits of trees.

(*c*) *Derived from fruits.*

MYROBALAN.

Myrobalan (Ver. Harra).—The fruit of *Terminalia chebula* (*vide* Part I.) is an effective auxiliary in tanning, since it is found to mix advantageously with babúl bark. It has to be well ground or crushed before it will yield its tannin.

In the Cawnpore Government Factory myrobalan is used with babúl bark in the proportion of 16 per cent., with good results in economy of bark and superior brightness of colour. Cawnpore imports its myrobalans chiefly from Mirzapur and Central India. TANNING AGENTS.

Bahera, the fruit of *Terminalia bellerica ; Nat Ord. Combretaceæ.* BAHERA.

Description.—Tree, 100 feet ; leaves about the extremities of the branchlets, long petioled, obovate, quite entire, glabrous ; spikes axillary, solitary, almost as long as the leaves ; bisexual flowers sessile ; male shortly pedicellate ; drupe obovate, obscurely 5-angled, fleshy, covered with greyish silky down ; flowers fetid, small, greyish green (Drury).

This fruit is also included in the myrobalans of commerce, and is used as a tanning agent.

The following table shows the exports of *bahera* from the North-West Provinces forests during the years 1874-75 and 1875-76 :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Najíbabad	36¼	50	18¼	37
Garhwál	135¾	219	7¼	12

The fruit of the Ghunt (*Ziziphus xylopyra*); *Nat Ord. Rhamneæ.* GHUNT.

Description.—Tree ; stipulary prickles solitary, or in pairs, or wanting ; leaves alternate, broadly elliptical or orbicular, slightly cordate at the base, serrulated, under side pale, softly pubescent, finely reticulated, upper side pubescent when young ; cymes short; ovary 3-celled ; styles 3, united below ; drupe turbinate ; nut globose, hard, slightly rugose, 3-celled ; flowers greenish yellow (Drury).

The berry of this tree yields a considerable amount of tannin ; its bark is also used in Bundelkhand as a tanning agent in company with the leaves of the *dha* shrub.

The fruit of the Bilawa (*Semecarpus anacardium*) ; *Nat Ord. Anacardiaceæ.* BILÁWA.

Description.—Tree, 50 feet ; leaves entire, cuneate-obovate, rounded at the apex, whitish beneath, but not downy ; calyx flat, 5-cleft ; petals 5, sessile, spreading ; flowers panicled, terminal, branched ; fruit sessile, cordate-ovate, with a slight notch on one side under the apex ; flowers small, green (Drury).

Exported from the forests of the North-West Provinces. Pounded and boiled in rape oil, it makes an excellent remedy for staying putrefaction when begun in a hide. It is also used as a varnish.

TANNING AGENTS.

The subjoined table shows the exports during the years 1874-75 and 1875-76 :—

Whence exported.	1874-75.		1875-76.	
	Weight in cwt.	Value.	Weight in cwt.	Value.
		Rs.		Rs.
Rehar	½	4	½	4
Kumaun	...	...	22	37

The tanning substances mentioned above are all produced from trees or plants growing in these provinces. The following one is the fruit of a tree which is a native of South America, but which efforts are being made to naturalize in this country.

DIVI-DIVI.

Divi-divi, the seed pod of *Libidia corriaria; Nat. Ord. Leguminosæ.*

A most valuable tanning agent. This tree already naturalised in Western India has lately been planted in the grounds of the Government factory at Cawnpore. There is promise of a good plantation that willyield about 73 cwt. pods per annum. Steps are being taken to extend its cultivation round Cawnpore.

The foregoing list is known to be incomplete, but gives all the substances which, so far as present information goes, are known to be used in tanning by the people of these provinces. It might very easily be swelled by a catalogue of trees and shrubs, natives of these provinces, which are known to contain tannin in some portion or other, although as yet no advantage has been taken of this property.

Dyes used in colouring leather.

The following are the chief dyes which are used in colouring leather :—

Babúl bark ... ... buff.

For sheep, goat and deer skins (used by the chikwas)—

Lac ... ... red.
Sulphate of iron ... ... black.
Copper ... ... blue.

For fancy leather work (used by the slipper-makers, scabbard manufacturers, etc.)—

Sappan-wood ... ... red.
Harsinghár ... ... orange.
Multáni mitti ... ... yellow.

White skins are prepared by the *chikwas* without using any *tanning* agent, which may discolour them, but by simply curing them and working them well by beating, stretching, etc.

(2) THE METHODS OF LEATHER TANNING AND DYEING PRACTISED IN THE NORTH-WEST PROVINCES.

The following are the methods of curing and tanning practised in the Cawnpore and Etáwah districts. With a few unimportant alterations, the descriptions will apply to the whole of these provinces.

The operation of tanning is a process by which the *gelatin* of skins is converted into a tough flexible substance, resisting decomposition when damp and remaining soft and pliable when dry. The principal agent employed in effecting this change, in this country as well as in England, is a vegetable principle known as *tannin;* but certain mineral substances, such as *alum*, can produce much the same effect with far less trouble, if used for thin skins, in which there is no great thickness of gelatin to be acted upon. These two processes are in England distinguished by the names of "tanning" and "tawing;" a third process, in which oil is the chief agent used, is called "chamoying." The result of enquiries seems to show that neither "tawing" nor "chamoying" are practised in this country, except perhaps in the case of white skins, which are sometimes cured with alum. The methods of "tanning" practised differ very much according to the locality and the class of tanners who follow them. In the city of Cawnpore there are two distinct castes engaged in tanning—the *chamárs* and the *chikwas;* plain tanning is restricted to the former, while the latter monopolise a more elaborate process, by which skins are dyed in colours, and which is something akin to *tawing*.

The chamárs.

The *chamárs* are the largest of all the Indian castes, as well as very nearly the lowest. In every village there are certain men of this caste called "*ganw kama*" or *village servants*, whose residence is permitted by the land-holder on condition of their performing certain services for himself and his cultivators, in return for which they have certain petty dues and rights, such as a double handful of grain out of the produce of each field. One of these dues is the right to the hides of all cattle which die in the village, and this has been known to lead in some of the eastern districts of these provinces to a wholesale system of cattle-poisoning in order to get their hides. The village *chamár* takes the hide to his brethren engaged in tanning, called *rangi chamárs*, and sells it to them for some Rs. 3 or Rs. 4.

The chikwas.

The *chikwas* are a Muhammadan caste related to the *kasáis* or butchers.

The process of tanning. Preparatory cleaning.

All tanning processes commence in preparing the skin by the removal of those portions which are useless or detrimental. A skin consists of three layers: the outermost is a double one, consisting in (i) the epidermis which carries the hair, and (ii) the Malpighian layer, in which are contained the nerves, blood-vessels, and roots of

the perspiration glands; the second layer is the *derma* or *corium*; and the third is a fat-bearing tissue lying between the derma and the muscles of the flesh. It is of the second layer, or *derma*, that (properly speaking) leather is made. The third or fat-bearing tissue and the epidermal portion of the first layer are removed altogether. The Malpighian portion of the first layer remains and becomes the "grain" or "bloom" on the leather.

The hide is steeped in water for a day and a night, and all flesh that may be adhering, together with as much as possible of the fatty tissue, are scraped off with a sharp iron instrument called a *rámpi*. It is then washed and plunged into a vat filled with a solution of lime and *rassi* (carbonate of potash and carbonate of soda) in water. It remains immersed in this for some 10 days, at the end of which it is taken out and cleaned with the *rámpi*; this time the epidermis, with the hair and what remained of the fatty tissue, being carefully taken off. Occasionally, instead of the skins being plunged into a mixture of the lime and *rassi*, it is plastered with a paste of these substances and soaked in a vat filled with water for some 10 or 15 days. This is the method in England with thin or delicate skins, which are plastered with slaked lime and orpiment instead of being soaked in lime. The skin now consists of the *derma*, which is the portion of which leather is really made, and the inside portion of the outer layer, which will become the "bloom" or "grain."

Liming.

In England the application of the tan is preceded by another preparatory process called "raising;" for this the skin is immersed in a *sour bath* of weak acid, which neutralises the lime which was previously applied, and has the further effect of swelling out the pores of the skin, and thus preparing it to receive the tanning agent readier and quicker. The neutralisation of the lime is most important, since lime or any alkali decomposes tannin, and would render its application entirely useless.

The sour bath.

In this country the *sour bath* is an infusion of tanning substance itself, which, having been kept for some time and already used once or twice, has developed certain vegetable acids.

Three vats are used for this process: in the first is an infusion of babúl bark (*kas*) which has already been used twice, and is thence called *tiranga* (third dye); in the second is an infusion used once previously (*doranga*), and the third contains a fresh and hitherto unused infusion made by soaking strips of the bark in water for some months. The hide is immersed in each vat in succession for a day and a night.

The first two vats appear to act as a *sour bath* and to prepare the skin for the reception of the fresh tannin of the third vat.

Tanning.

When it has thus been passed through the vats the skin is roughly sewn up into a bag with string made of *munj* grass (*Saccharum Mungo*), the *outer*

side being innermost. The bag is filled with an infusion of babúl bark, which is allowed to filter through it for three days, when it is taken down and turned inside out, so as to expose the inside surface of the skin to the action of the tan, refilled with infusion of babúl bark, and allowed to hang for another three days. The skin is then again immersed in a vat of babúl bark infusion (or "ooze") for 15 days, during which time fresh bark is twice added, the old bark being removed. It is then pressed dry and the inner side rubbed with khari salt. It is then ready for sale to the leather manufacturer. The time taken in the whole process is about 38 to 40 days.

What differences there are between this method of tanning and that followed in the other districts are not so much in the process itself as in the tanning agents employed, which of course depends on the resources of the district, since, if a tanning agent is to be got cheaply or for nothing, it will certainly be used in preference to what may be a more effective but more expensive tan. Babúl bark is almost exclusively used in the districts of the Jumna and Ganges Doáb. In Bijnor its place is occasionally taken by the bark of sál (*Shorea robusta*), *amaltas* (*Cathartocarpus fistula*), *ber* (*Zizyphus jujuba*), by the fruit of the *bahera* (*Terminalia bellerica*), the *harra* (*Terminalia chebula*), and the gum of the *bankri* (*Anogeissus latifolia*)—all of which are there easily obtainable. In Bundelkhand *babúl* pods, *mahúa* leaves (*Bassia latifolia*), and the berry of the *ghunt* (*Zizyphus xylopyra*) are much used, the latter especially, while mango leaves are occasionally employed by the poorer classes in Oudh.

The method of tanning above described is only followed with the hides of bullocks, cows, &c., and *dyes* them of a buff-brown colour as well as tanning them.

Small skins, such as those of the goat, deer, &c., are generally cured by the *chikwas* something after the fashion known in England as "*tawing*," and are dyed in fancy colours. The variety of these latter is not large, being buff-red, white, blue, and black. Even the *chikwas* are subdivided into two "guilds," one of which dyes in the three first, and the other in the two latter of the colours enumerated. The operations of dyeing in these two sets of colours differ in the preparatory processes as well as in the actual colouring. The method of preparing a skin which is to be dyed buff, red, or white will be described first.

The skin is soaked in water and scraped, then placed in lime-water for some 10 days, again scraped, and then replaced in the lime-water for another week. The skin is then daubed with a paste made of wheat flour, khari salt, and the juice of the *mádár* (*Calatropis gigantea*), and is left to soak in a vat of the same mixture for from 15 to 20 days, being taken out once, washed, and replaced. At the end of this time the epidermis, hair, and fatty tissue are got

LEATHER TANNING AND DYEING.

rid of, and the skin is made soft and ready to receive the dye which is to be applied to it.

If this is to be *buff*, the skin is simply allowed to soak in infusion of babúl bark for 15 or 20 days. If it is to be red, it is soaked for ten hours in a *mixture of lac* (2 lbs.), *lodh* (½ oz., 1 part), and *sajji* (2 oz.), which have all been boiled together in two gallons of water. Occasionally this mixture is merely rubbed on to the skin. In any case, the red dye it gives is permanent. The skin is then soaked for six days in infusion of babúl bark, which completes the operation.

If the colour is to be white, all that is applied is a solution of khári salt, in which the skin is allowed to soak, being repeatedly taken out, wrung, stretched, beaten, and worked with the hands. It is on this working that the degree of its whiteness depends. Whether dyed buff, red, or white, khári salt is rubbed on to the inner side of the skin as soon as the dyeing operation is concluded.

The "guild" of *chikwas*, which dyes leather blue and black, prepares the skins by soaking them in lime and water from 5 to 15 days. If the colour is to be blue, the skin is soaked in a mixture of copper (*zangár*), sal-ammoniac, and lime in water. If it is to be *black*, sulphate of iron (*kasis*) is used instead of copper. Or the skin, if blue is intended, may be first steeped in water acidulated with a vegetable acid (such as mango juice) and let to soak in a mixture of sal-ammoniac and copper and lodh for 24 hours, when it is rubbed with the juice of the *mádár*.

Black dye (*kasis*) may be applied to a skin which has been dyed buff with babúl bark.

The price of a raw bullock's hide is about Rs. 3 or Rs. 3-8-0 ; when tanned by the chamár it sells for about Rs. 5-8-0.

Most "fancy" leather work is done by the shoemakers and scabbard-makers, and they dye (in a more or less imperfect manner) in a considerable variety of colours. All of these are applied to prepared leather, some to leather which has already been dyed buff, others to white skins only.

For *red* either the flower of harsinghár or sappan-wood may be used, the former giving much the brighter shade. The harsinghár flowers are boiled with a mixture of suet, oil, and wax, forming a paste which gives a red tinge to leather by being rubbed on it and left to dry in the sun. Sappan-wood is applied in the shape of an infusion made by boiling strips of the wood in water. This, too, is merely rubbed on to the leather. Black is produced by a mixture of sulphate of iron (2¼lbs.), *mádár* juice (2¼lbs.), and myrobalan (4½lbs.) boiled together in water and applied to the leather with a piece of cloth. *Yellow* is only applied to white skins, generally those of the *Sambar* deer; the leather is rubbed with a mixture of *Multáni mitti* and chalk in water, and frequently soaked in *Multáni mitti* with curds.

APPENDIX I.

A.—NOTE ON THE CULTIVATION OF INDIGO WITHOUT IRRIGATION, FURNISHED BY EDGAR HILL, Esq., OF SHAHPUR HOUSE, NEAR ALLAHABAD.

In the non-canal districts of Benares, Mirzapur, Jaunpur, and Allahabad, irrigation sowings till lately were unknown, but still indigo formed an important article of industry. In the European factories, seed is sown at the commencement of the rainy season alone without any subordinate crop. The land is ploughed two or three times, and seed sown at the rate of 5 seers per bígha. When the plants are high enough, two weedings are given. The total cost of cultivation is about Rs. 3 per bígha. The plant is cut in latter half of September or first half of October. This cutting is called the "nandah," and weighs about 10 to 18 cwts. per bígha. Cost of cutting is Re. 1-4-0 per 100 cwt. by contract. The plants intended for seed are left growing on the field till December, when they yield about 2 maunds per bígha. Shoots come out from the stalks of plants cut in September or October, which are pruned in March and April at a cost of 3 annas per bígha, and the field once ploughed over at commencement of the rains, the cost of which is 2½ annas. The second crop, called "khunti," thus obtained is cut in August, and yields about 30 to 40 cwt. of plants.

Natives generally sow indigo mixed with other crops. When mixed with juár, it is sown after the first shower of the rains—say middle of June. The yield per bígha is about 3 maunds of juár and 10 cwt. of indigo of the first cutting, and 25 cwt. of the second cutting in August following year. It is also frequently sown as a subordinate crop to bájra and arhar. In this case the land is ploughed six to eight times, and seed sown in August, the quantity of seed sown per bígha being 3 seers of indigo, 1¼ seers of bájra, and half a seer of arhar. The outturn per bígha first year is—bájra, 6 maunds; arhar, 2 maunds; indigo, *nil*. In the following August 25 cwt. of indigo plant are obtained. Natives generally manufacture from it the kucha indigo called "gadh."

The size of the bígha is $\frac{5}{8}$ths of an acre.

B.—STATISTICS OF AREA UNDER INDIGO IN 1876-77 IN THE SEVERAL DISTRICTS OF THE NORTH-WEST PROVINCES.

Division.	District.	Area under indigo.	Remarks.
		Acres.	
Meerut ...	Dehra Dún...	...	
	Saháranpur	1,097	
	Muzaffarnagar	3,297	
	Meerut	6,079	
	Bulandshahr	26,341	
	Aligarh	45,886	
Rohilkhand ...	Bijnor	1	
	Moradabad	1	For one tahsíl only.
	Bareilly	829	
	Budaun	1,150	
	Sháhjahánpur	428	
Agra ...	Muttra	1,333	
	Agra	7,099	
	Mainpuri	17,035	
	Farukhabad	13,560	
	Etáwah	12,996	
	Etah	10,262	

Division.	District.	Area under indigo.	Remarks.
		Acres.	
Allahabad ...	Cawnpore	22,771	
	Fatehpur	1,775	
	Banda	97	
	Allahabad	356	
	Hamírpur	64	For one tahsíl only.
	Jaunpur	2,667	
Benares ...	Azamgarh	2,882	
	Gorakhpur...	14,363	
	Basti	27	
Jhánsi ...	Jalaun	297	
	Jhánsi	52	
	Lalitpur	...	

No returns are obtainable from the province of Oudh, for the permanently-settled districts of Mirzapur, Benares, and Gházipur, and for portions of the Moradabad and Hamírpur districts.

C.—INFORMATION REGARDING SIZE OF VATS AND PROPORTION OF DYE OBTAINED FROM THE PLANT.

From Mr. Herbert Smith of Barla Factory in Meerut.

1*st*.—The ordinary size of an indigo vat is 20 feet × 18 feet × 3½ feet deep.

2*nd*.—The ordinary amount of plants steeped in it is 75 maunds.

3*rd*.—The average outturn of dye from 2 to 9 seers.

This year, up to now, we have not been able to produce more than 6 to 7 seers from a vat.

From Mr. Gilmore, through C. Watts, Esq., Collector of Farukhabad.

A vat 20 feet squre and 3½ feet deep measures 400 cubic feet and contains 100 maunds of indigo plants, which will yield in a fair season an average of 12 seers of dye.

From Kanauj, through the Collector of Farukhabad.

In large indigo factories the vats are 23 feet × 21 feet × 6 feet high, and the smaller gadh *nil* vats that one sees about the villages are 9 feet × 9 feet × 6 feet high.

The former will hold from 125 maunds to 75 maunds at a time, or on an average about 100 maunds; and the latter from 40 to 20 maunds, or on an average 30 maunds of plant.

Average outturn of dye, 8 seers in the former and about 3¼ in the latter.

From Tirwa, through the Collector of Farukhabad.

The vats are 15 feet × 18 feet × 4½ feet high, which will hold about 119 maunds of plant, and that again would yield 8 seers of indigo.

From Mr. Michel, Dasna Factory, Meerut District.

The ordinary size of indigo vats ranges as below, and is used with relation to facilities for filling them and extent of crops and manufacturing :—

25 maunds plant	...	10′×10′×3	=300 cubic feet.
45 „ „	...	12′×12′×3′ 6″	=504 „
85 „ „	...	15′×15′×4′	=900 „
105 „ „	...	16′×16′×4′ 6″	=1,154 „
205 „ „	...	20′×20′×5′	=2,000 „

This gives the average weight of plant that may be got into them over a long series of crops, though (as in this season) quite 20 per cent. more may be got into them with ease, the plant being almost leafless and feeble with little bulk and great weight.

The outturn of dye varies even more. Here is the experience of last thirteen years most carefully registered, our plant being all weighed in the cart on a first class weigh-bridge with the utmost care and accuracy :—

		Plant. *Mds.*		*Dye.* *Mds.*				
1865	...	60,723	give	155	=	1	in	400
1866	...	91,439	„	203	=	1	in	450
1867	...	73,735	„	200	=	1	in	366
1868	...	19,362	„	65½	=	1	in	300
1869	...	96,060	„	315	=	1	in	305
1870	...	58,321	„	162	=	1	in	366
1871	...	1,07,636	„	212	=	1	in	507
1872	...	97,110	„	195¼	=	1	in	498
1873	...	1,26,615	„	226½	=	1	in	559
1874	...	99,330	„	153½	=	1	in	646
1875	...	1,01,472	„	280½	=	1	in	361
1876	...	1,36,403	„	385¾	=	1	in	353
1877	...	2,39,115	„	791¾	=	1	in	302
						13	in	5,413
						1	in	302
						12	in	5,111

From the above it will be seen that in the first twelve years the average is 1 in 426, which is the fairest result to accept. The last year having been an unusually good season for produce on a largely extended manufacture out of all proportion to the quantities dealt with in previous years, the result was, then 1 in 416 maunds; 1 in 425 may therefore be accepted as a true result, and calculations may be based on it for all European factories working for fair quality of colour.

But for Native factories looking to produce alone, from personal observation I am led to the conclusion that 1 in 300 would be a fair average, though I have not sufficient data to affirm it as a fact.

D.—QUANTITY OF INDIGO EXPORTED FROM NORTH-WEST PROVINCES TO CALCUTTA FROM 1840 TO 1866 (FURNISHED BY MESSRS. THOMSON AND CO., CALCUTTA).

	Benares.	Other places.		Benares.	Other places.
	Mds.	Mds.		Mds.	Mds.
1840 ...	12,171	9,665	1854 ...	23,379	13,473
1841 ...	17,611	11,760	1855 ...	16,176	14,887
1842 ...	19,046	5,392	1856 ...	14,147	20,368
1843 ...	12,817	9,662	1857 ...	5,100	3,500
1844 ...	16,369	6,366	1858 ...	9,987	9,251
1845 ...	16,712	9,300	1859 ...	14,973	16,407
1846 ...	18,783	7,855	1860 ...	12,282	13,600
1847 ...	9,027	8,596	1861 ...	15,763	19,500
1848 ...	10,113	5,620	1862 ...	9,940	20,450
1849 ...	9,850	6,600	1863 ...	10,554	7,880
1850 ...	10,440	10,470	1864 ...	12,557	11,183
1851 ...	13,142	9,840	1865 ...	20,202	12,756
1852 ...	13,210	14,980	1866 ...	18,858	12,735
1853 ...	18,624	14,991			

E.—QUANTITY OF INDIGO EXPORTED FORM NORTH-WEST PROVINCES TO CALCUTTA FROM 1867-68 TO 1876-77 (FURNISHED BY MESSRS. MORAN AND CO., CALCUTTA).

	1867-68.	1868-69.	1869-70.	1870-71.	1871-72.	1872-73.	1873-74.	1874-75.	1875-76.	1876-77.
Benares.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds	Mds.	Mds.	Mds.	Mds.
European ...	...	...	8,420	3,701	4,724	5,444	6,934	4,730	6,696	7,200
Native ...	11,110	17,776	4,543	3,656	5,621	3,830	3,670	2,613	3,215	4,800
Total ...	11,110	17,776	12,963	7,357	10,345	9,274	10,604	7,343	9,911	12,000
Doáb.										
European ...	...	...	4,807	4,314	4,710	4,258	5,472	5,205	4,863	5,500
Natives ...	14,683	30,570	15,028	13,317	12,850	13,966	14,942	15,928	22,768	25,800
Total ...	14,683	30,570	19,835	17,631	17,560	18,224	20,414	21,133	27,631	31,300
Gross total from North-West Provinces factories,	25,793	48,346	32,798	24,988	27,905	27,498	31,018	28,476	37,542	43,300

Exports of Indigo to Calcutta by the East Indian Railway for half-year ending 31st March, 1878.

From Meerut division.	From Agra division.	From Allahabad division.	From Benares division.	From stations on Oudh and Rohilkhand Railway.	From Muttra-Háthras Railway.	Total.
Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Msd.
19,246	10,659	7,020	5,664	3,711	371	46,671

Since the half-year between October and April is the period during which most of the indigo is sent down country, these returns, though not extending over the whole year, give a good clue to the year's total export.

The exports of indigo from Oudh stations on the Oudh and Rohilkhand Railway to Calcutta were registered during the whole of 1877-78; they amounted to 823 maunds, so that the greater part of the 3,711 maunds sent to Calcutta from Oudh and Rohilkhand Railway stations in the latter half of 1877-78 must have come from places in Rohilkhand or Benares, chiefly the latter.

The following figures are given in Messrs. Moran and Co.'s market report, dated Calcutta, 16th February, 1877:—

"Assuming the total outturn of the year's crops to be about 1,04,000 maunds, the following will show what the various divisions have made:—

	Mds.	Mds.
Lower Bengal, European say	20,300	
Ditto Native	3,700	
		24,000
Tirhut, Chumparan, and Chapra...	...	42,000
Benares and the Doáb, European	12,700	
Ditto ditto Native	25,300	
		38,000

This is for the year 1876-77.

APPENDIX II.

NOTE BY COLONEL JOHN STEWART, R.A., SUPERINTENDENT, GOVERNMENT TANNERY, CAWNPORE, ON PROCESS OF TANNING LEATHER AT THE CAWNPORE GOVERNMENT TANNERY.

(Taken from "selections of N.-W. P. Govt. Records," Vol. III.)

THE tannery consists of a long building, in the floor of which are masonry pits plastered with chunam. The floor is on two levels; the lower contains the *beam house* and *lime pits*, where the hair and flesh of hides are removed by the action of milk of lime, and also the *bark taps* and *spenders*, where the bark is infused. The latter are large masonry pits, with false bottoms of wood, through which the infusion drains off by plug-holes into a well adjoining, where a pump is fixed, and the liquors are raised and carried into the *tan pits* on the higher level; these are the pits in which the hides are tanned, and they drain off into the spenders and taps on the lower level.

Buildings.
The tannery.
Lime pits.
Bark taps.
Spenders.
Tan pits.

The currier's shop is a long two-storied building; the lower story is furnished with currier's beams and scouring tables of stone, where the hides are shaved and scoured preparatory to being oiled and dubbed. The upper story is for finishing the currying process. It is furnished with wooden tables for setting out and dubbing the hides, which are hung up to dry on battens suspended from the roof. There are arrangements for hanging the hides on both stories.

The currier's shop.

The hides and skins tanned and curried are—buffalo, bullock and cow, and goat and sheep skins. Buffalo hides are obtained from the slaughter markets of Cawnpore and adjacent towns and cities. They are either green direct from the butcher or drysalted. They are best suited for tanning in the former condition, as the salt cure of the North-West Provinces is inferior and imperfect, absorbing so much moisture that in the damp heat hides are apt to rot; while the dry heat of the climate so hardens and contracts the fibres of the skin that much labour is required to loosen the pores to receive the lime and tan. Great precaution, therefore, is necessary in the selection of drysalted hides, especially as native dealers lay on the khári or salt very thick to gain weight. If the hides are fresh slaughtered and have been lightly cured, they soak downto a natural state; but if they are stale—that is, have been cured some months and are besmeared with khári—the tanner should reject them, for they will very likely decompose in soak before becoming soft.

Raw materials.
Buffalo hides.

The buffalo is the only available hide that will produce leather thick enough for harness work in this country, and there is no doubt that much of the inferiority of country leather arises from the poorness of the skin of that beast. It is poorly fed, not generally cared for, and usually killed when too old to breed or give milk.

The hide of the male buffalo is too coarse, and it gets such bad treatment in the plough or cart that it is generally full of sores and goad marks. In large towns there is a market for buffalo beef for the low caste and poorer Mussalman population, and also for grease, and younger and better cattle are slaughtered; it is from these that the local tanners select their hides for the finer uses of harness, saddlery, and accoutrements.

Many good hides are ruined by the butchers in flaying, from inefficient arrangements in the slaughter-houses, and from injudicious use of their tools.

Bullock and cow hides are also procured green and drysalted, and the same care is necessary for selection. Those slaughtered in the Commissariat Department are usually the best; but they are small and unfit for any thick work. This class of hides is much exported to England, and extensively used there for boot and shoe upper leather, for which it is much esteemed. In the English market there is great objection to North-West cure. Patna, Dacca, and Durbungah cures, though the hides

Bullock and cow hides.

are no better, are far preferred. The finest hides of this description are those killed at Agra, Delhi, and Meerut. Much damage is done to the hide by branding on the butts and shoulders.

Goat and sheep skins.

Goat and sheep skins are always obtained green from the local market. Goat skins are generally very good; sheep are poor and small.

White or stone lime.

Lime is brought into Cawnpore chiefly from the Bánda district, and is used for loosening the hair and flesh of hides and killing the grease. It should be taken in lumps, unslaked.

Bran.

Bran is obtained from the Commissariat Flour Mills or from the bazars, and is used to produce an acid, when fermenting in water, which plumps up the skin, opens the pores, and takes out the excess of lime.

Tanning agents.
Babul bark.

Babúl bark is obtained locally, the wood being extensively used for firing. The bark season extends from January to June—that is, the spring of the year, when the sap is upon the tree; from six to ten year old trees are the best for bark. It should be peeled from the trees immediately after they are cut down.

The natives are rather careless in this particular and ill use the bark; for, to get it separated from the wood, they beat it with wooden mallets and gash it about to get it loose; they then peel it off by hand; each gash is a wound in the bark through which the tannin evaporates. In England a peeling iron is used, and long strips of bark are taken off without any beating; but of course this must be done before the sap has dried. The tannin is contained in the white or inner stratum of the bark.

The tannin is stronger in babúl than in oak bark, but the quality is not considered so perfect. Experiments tried lately in England under Professor Abel, the Chemist to the War Department, proved it to have keeping qualities quite equal to oak bark, if not superior; and thus it is valuable as a tanning agent. It has more colouring matter—that is, gives a reddish liquor, which is somewhat against it, and great advantage is found from mixing with it "har"

Myrobalans,

or "bahera" (the myrobalans of commerce, the dried fruit of *Terminalia chebula*), which is plentiful in the markets, and is used extensively as a dye. The liquor from the "har" or "harra" is powerful in tannin; and though it is not reputed to be of a quality that would make good leather of itself, it is highly esteemed in England to mix with other tanning agents, owing to the bright colour it imparts: and herein is its usefulness in combination with babúl. The "har" is a product of the forests and is very common, but the natives of Cawnpore use it only as a dye.

Sumach.

Sumach is another tanning substance which has been used in small quantities here, but only for finishing and imparting colour. It is imported from England, and is therefore very expensive. It will not be much used hereafter, as the myrobalans is found to answer quite as well.

Terra Japonica or kutch.

Kutch is a very powerful astringent and rich in tannin. It is the inspissated juice of *Acacia catechu*, the "khair" of the forests, and is used by the natives for a dye, and also eaten with pán. Its tannin is three or four times stronger than that of oak, but of poor quality. The leather made of it is dark in colour and does not last well, but it tans so quickly, and therefore so cheaply, that it is used extensively in England; such leather is believed to be unsuited for wear in this climate. At Cawnpore the kutch is used only for darkening colour, when that is required.

Divi-divi.

Divi-divi is the seed-pod of a shrub that is a native of South America, but grows well in the Madras and Bombay Presidencies; it is called the *Libidibia corriaria*. The pod is exported to England from Bombay, but in small quantities. The tannin is strong, and considered good for mixing with barks. The shrubs were grown from seed at Cawnpore, and a few are still living. Government has now

sanctioned a plantation of it, and some hundreds of plants are doing well in a nursery. It has been little used as yet, but will probably be a useful auxiliary in tanning.

Other tanning barks

The barks of sál, asseyna, and amaltás are known to contain tannin, and experiments are being carried out with them.

The only oil used for currying is cod-oil ; it is obtained from England, and is the best known for the purpose. Indian fish oils would answer if more carefully extracted.

Cod-oil.

Mutton or goat tallow is used either alone or mixed with cod-oil ; in the latter state it is called dubbing, which is applied to all leather intended for harness or straps, and like pliable purposes.

Tallow.
Dubbing.

Native tanners and curriers are all of the chamár caste. The former are ranghias, a trade class of that caste. Such labour is very plentiful about Cawnpore. The wages vary from Rs. 9 to Rs. 5 per mensem, according to skill.

Labour.

The hide when received green is only washed and put into a pit of milk of lime ; when it is drysalted it has to be soaked in soft water before it can go into lime. It is often so hard dried that it will not soak down, and heavy fulling stocks are required to break it down and soften it.

Liming.

These stocks have not as yet been set up at Cawnpore for want of power to drive them ; and until they are used, the tanning of dry hides cannot be satisfactorily carried out.

Stocks.

The hides are first put into a weak lime, and then into a stronger, until the hair is loosened and the skin plumped up ; they are then placed over tanners' beams made of wood and convex, so that a two-handled, blunt, concave knife can be worked over them to push off the hair ; when that is done the hide is turned over on the same beam, and the flesh and fat which was left on and has now become loosened by the action of the lime is shaved off by means of a two-handled concave fleshing knife which has a sharpened edge, and takes off a greater or less shaving as required. Some dexterity is needed in this work, as a slip of the knife may shave too deep and cut into the hide. The most skilled tanners are employed in this, and are called beamsmen.

Unhairing and fleshing.

There is great diversity of opinion in the trade as to the use of lime. It is generally allowed that it is an evil, but a necessary one. It is not good for leather, but the hair and flesh must be removed, and there is no safer way of doing so. In France and in some American tanneries they remove the hair by sweating the hides and producing partial decomposition; but this would be too dangerous in a climate like that of India.

Lime being an evil, it becomes necessary, after it has done its work, to obliterate all trace of it in the fibres of the hide ; and this forms the second process of the tanner, and is called "grainering" or "bating." Sole leather does not require this process, but for all harness or dress leather and for every soft purpose it is essential. The hides, after being unhaired, fleshed, and washed, are thrown into a pit called a "grainer," in which bran and water have been allowed to ferment ; the acid thus produced removes the lime from the fibres of the skin and loosens and distends the pores, so that they are cleansed of every foreign substance and brought to a state that is very sensitive to the action of tannic acid.

Grainering or bating.

Bran grainer.

Much caution is needed in India for the management of "grainers," for if the hides are left a few minutes too long, the acid dissolves the gelatinous fibres, the action being quicker than in England owing to the higher temperature.

Bran being sometimes expensive, the acid or ammonia from pigeon or hen dung has been tried with some success ; this is the usual grainer in England, but there has been difficulty in collecting sufficient quantities of it at Cawnpore, and it is usually so full of dirt that bran is preferred.

Pigeon or hen dung grainer.

The native tanners of Cawnpore use a grainer of stale fermenting tan liquor, and it is so inexpensive that it would be well to introduce it gradually in the Government Tannery. It is notable that the French use stale rotten liquors to bring down or soften their skins, and they are most successful in their soft pliable leathers.

Stale tan liquor grainer.

Weak solutions of sulphuric acid have been tried to plump up the skins, but it is more expensive here. All these grainers give more or less the same results.

Sulphuric acid grainer.

An experienced tanner can tell by feeling the hides whether they have been brought down enough and are fit for the next process, which is the tanning proper.

After the grainer and before going to the tan pits, the hides are once more put on the beam, and all dirt, short hairs, &c., that may have been left in the pores are driven out by means of the blunt knife.

Babúl bark is broken and ground in a "bark mill with breakers." The latter breaks the fibres of the bark, and the mill crushes and grinds it, and renders it easy to infuse in cold water, for the tannin to be extracted. One bark mill is driven by bullock power, but another has now been set up for steam power. The mill resembles a coffee mill on a large scale. The same power which works it is made to work the tannery pump.

Bark grinding.

Myrobalans are pounded or crushed to a powder, when dry, in a surkhi mill. Other barks and tanning agents are also either ground, crushed, or pounded.

First infusions are made in the bark taps, before described, with fresh cold water; soft water is of course the best both for this and for soaking hides in the first stages in the beam house, and it should be free of lime for the tanning process.

Tannnig proper.

Cheap tanners in England infuse with hot water; but this is not considered good, as it extracts too much of the colouring and other earthy matters, and hastens the development of gallic acid, which is injurious to the liquors.

Infusiug barks.

After a pit of bark has given off a liquor, the half-spent material is cast over into one of the spenders, where afterwards a half-spent liquor is put on it, and is freshened up with it, and so on till the bark is quite spent, when it is thrown out. The liquors are continually worked over and over to spend the bark.

Spending barks.

The hides are first put into the oldest or weakest liquor. In the state in which they come from the grainer they should not be subjected to the too sudden action of tannin; they are therefore continually handled or taken in and out of the pits. The pits are called "handlers." For the first month the hides are handled first hourly, then gradually allowed to remain longer and longer till they are fit for the next stage, which is called "dusting." The pits are called "dusters;" and the hides are put into a stronger liquor with some finely-ground bark thrown in between each layer of four or five hides, to keep the strength of the liquor up as the hides drink in the tannin.

Handling.

Dusting.

In the "dusters" the hides are taken up weekly, and then fortnightly, when new liquors are supplied and fresh bark as before.

The dusting goes on for three or four months, and then the hides are ready for "laying away." The pits are now called "layers," and the hides are put into a new strong liquor, with quantities of fine bark between each hide. In these pits they lay for a month or two at a time feeding on the tannin. The half-spent liquors from layers, dusters, and handlers are always drained off on to the top of the spenders, and these after being freshened up are brought up again by means of the pump; thus they are kept

Laying away.

moving, which is very important, as it retards the formation of gallic acid, which is injurious to the tannin, and which is too apt to form in hot weather.

Babúl bark and myrobalans are infused together, and the addition of the latter adds great strength and takes from the deep colour of the liquors.

Time taken in tanning.

The hides are kept three or four months in layers, and by that time in general the tannin has struck right through them, and they are tanned. Buffalo hides take from nine months to a year from first to last, according to weight and substance; cow hides are tanned in from four to six months; sheep and goat skins are done in tubs, and take from a month to two months.

The climate of India is favourable to the penetration and combination of tannin with the gelatine of hides. The chief object to guard against is the fretting of liquors and production of gallic acid, which is more readily given out owing to the atmospheric heat.

After the hides are tanned, they can be dried and stored; but in this country they are apt to dry so hard and to darken so much by the action of light and air, that it is thought best to curry them at once, especially for harness work or dress leather. For sole leather or crop hides no currying is required, but they are "struck—" that is, pressed down and rolled, and then stored.

Native tanning.

Native tanners carry out the liming process very much like any others; they, however, rather over-lime the hides, according to English ideas. Their grainer is very effectual as far as softening the skin; they then rinse out all moisture, and while the pores are yet open, they work the hides in liquor, and afterwards they sew the hide up into a bag having one end open. This bag is filled with finely-pounded bark and hung up over a pit, from which liquor is ladled into the bag, and there a very strong infusion is formed, which percolates through the pores of the hide. The tannin, therefore, goes right through the hide, but it has not time to make a chemical combination, which is considered so essential for leather.

Native tanning does not occupy more than a week.

Currying.

For harness and all dress purposes the currying is a most necessary and important process. By tanning the hide has become leather, but it is not fit for use without currying. This consists of a number of manipulations—stoning, shaving, scouring, oiling, re-shaving or flattening, setting, re-setting, dubbing, and finishing.

Stoning.

For ordinary harness leather, a buffalo hide, as it comes from the tan pits, is hung up till it is half dry, when it is stoned out with a rough stone on a flat table, to straighten it as much as possible. It is then thrown over a currier's beam, an upright thick plank faced with lignum vitæ. This is the beam board for shaving on. The hide is smoothed down the board, and the currier with a two-handled shaving knife having a turned edge takes off the outer flesh and inequalities from the flesh side; in fact levels the hide as nearly as he can do so, having regard to economy in not wasting leather. The object of this shaving is to get the hide to lie flat on a table, so that the scouring stones and sleekers may touch each part of the surface with equal pressure, and thus thoroughly clean it as well as press out all dirt and bloom, or earthy deposit from the bark that remains among the fibres.

Shaving.

Preparing the shaving knife.

The preparation and use of the currier's shaving knife requires skilled men. Each man sharpens and turns the edge on his own knife. He first grinds it and clears a perfect straight edge, then places his knife, edge upwards, before him on the floor, holding it between his knees, and resting it against the wall; in this position he takes in both hands a heavy steel and presses it along the straight edge, with more or less pressure as required to turn the edge. This edge catches the lumps and inequalities of the flesh side and shaves them off.

Turning the edge.

When shaved, the hides are laid flat on a stone table and undergo a series of scourings and pressings out on both sides, to remove bloom and dirt and take out creases. After this it is steeped for two days in sumach or myrobalans to give it a finishing colour. These infusions are made with boiling water.

Scouring.

Steeping in sumach water.

The hides are then taken to another table and sleeked out on both sides with an iron sleeker; then, while still wet, cod-oil is rubbed on lightly on the flesh, and more heavily on the grain. They are then hung up for the oil to be drawn into the pores of the skin as the water evaporates.

Oiling.

When about three parts dry, they are taken down and for a second time placed on the currier's beam, to be lightly re-shaved on the flesh side; that is, the roughness is taken off without sacrificing much of the leather. This process is called flattening.

Flattening.

After this they are hung up again to dry a little more. They are then stoned out on a table. Then the table, or sufficient surface on a table for the hide to lay on, is rubbed over with dubbing (a mixture of oil and tallow). The hide is laid on the dubbed table grain upwards, so that the flesh adheres to the table; in this state it is well set out—that is, the hide is stretched out as much as it will go by pressure with a hard setting stone with a smooth edge. To do this the hide is damped down in any places that it may have dried too much.

Setting on dub.

When fairly set it is allowed to dry a little, then stoned out on the flesh side, and afterwards re-set on the grain side to prepare for the dubbing, which is now laid on with a brush and rubbed in and smoothed down with the palm of the hand. Care must be taken that the hide is equally damped all over before it is dubbed, otherwise the dry parts will remain dark in colour. In this dry climate it is very necessary to watch that hides do not get too dry in the processes of currying. When dubbed, the hides are hung up to dry, and when the grease has gone well in, leaving a white coating of refuse tallow on the outside, they can be taken down and finished off, which is done on a table. First the flesh side is smoothed with a pebble or glass, then the grain is sleeked with a fine sleeker to remove the coating of tallow, then sleeked with the pebble and glass to make smooth and bring up a gloss. After all this, the hide is ready for the saddler and harness-maker. It is prepared for various other purposes with more or less dubbing, as the leather is required for soft or for hard purposes.

Re-setting.

Dubbing or stuffing.

Finishing.

Cow hides do not require so much setting as buffaloes, but they have oiling and dubbing in proportion to their thickness. For very soft uses the cow hides are softened by hand labour with a crippling board which loosens the grain.

Currying cow hides.

Sheep and goat skins are only oiled and softened; they are not set or dubbed.

Sheep and goat skins.

The following tools are used in tanning:—

Tools used in tanning.

Tongs, for lifting hides out of lime-pits.
Unhairing knives.
Fleshing do.
Rounding do.
Tanner's hooks for lifting hides out of tan-pits.
Scudding knives.
Striking pins.

The following tools are used in currying:—

Tools used in currying.

Currier's shaving knife.
Sharpening steel.

Turning steel.
Scouring stone.
Do. sleeker.
Pumice stone.
Setting stone.
Finishing sleeker.
Pebble.
Gloss sleeker.
Stuffing brush.
Crippling board.

Rub-stone and clearing-stone for sharpening knives.

Native currying.

The natives neglect the currying process with their leather. There is no trade corresponding to the currier's in this country. The best harness-makers curry their leather before cutting it up into straps; they curry it in strips of a foot wide and apply tallow only; very often they apply nothing but buttermilk, which gives the leather a very bright appearance, but the moisture very soon evaporates, and the leather becomes hard and brittle.

APPENDIX III.

LIST OF DYEING APPARATUS USED BY THE DYERS AND CALICO-PRINTERS OF THE NORTH-WEST PROVINCES.

Tabla.—Commonly called *taula* or *adhaia*, a tub made of copper. Its diameter measures 1½ feet; height 3½ feet. It is used for boiling dye solutions etc.

Kathilia.—A spoon used for measuring quantities, made of a half cocoanut shell with a wooden handle. Where cocoanut shell is not procurable, it may be made of any wood, excepting *Acacia Arabica* (*Babúl*). Value ½ to 1 anna.

Háwan-dasta.—Commonly though wrongly called "imám-dasta," mortar and pestle, usually made of iron and sometimes of brass. They are used for breaking dyeing substances into pieces; value from Re. 1 to Rs. 5.

Ukhli.—Mortar made either of stone or wood. It is fixed in the ground. Where a metal mortar is not procurable, this one serves the purpose. This is usually the case in villages. Value 2 to 8 annas.

Músal.—A wooden club, length varying from 3 to 4 feet. It does the duty of a metal pestle when the *ukli* is used. The thicker end is surrounded by an iron ring of about one inch breadth to keep it from splitting. It is generally made of *shísham* or *babúl* wood. Price varies from 2 to 8 annas.

Chalni (sieve).—May be made of two different substances:—

(1) *Bamboo.*—Thin strips of bamboo are fastened crosswise to make the bottom. The form of this kind of sieve is usually circular with sides all round about 4 inches high.

(2) *Iron.*—A small sheet of iron is pierced with holes and slanting sides attached to it, or portions of the sheet turned over and sides formed. Sieves made of iron are usually in the oblong form. It is very easily made of brass.

Chhanna.—A piece of cloth spread over a *tipái* (below described). It is used as a filter or strainer.

Tipái (tripod).—Four pieces of wood, each about 1½ feet long, are bound or nailed together forming the sides of a square. This frame is supported on three legs, whence its name.*

Gadia is the printer's colour pot, an oblong receptacle made of earth, stone, or wood.

Thathia.—A bamboo cage-work placed over the *gadia*. A piece of blanket is spread over this cage-work, on which in time of printing the die is placed, which, pressing down the cage-work, wets the blanket with the prepared colour in the *gadia*, and through it colours the mould itself. Horse-hair or other fibrous substance is sometimes substituted for the blanket.

Dát (dies), also called *bhant* and *datta*, are usually pieces of the best *shísham* wood, on which are carved out figures and flowers, &c., to be printed on cloth. They are of different shapes and sizes, and are also made of other kinds of hard wood, such as tamarind, *Cedrela toona*, *Shorea robusta*, &c. A *dát* is dipped in the colour in the *gadia* in the manner described above, and then pressed on the cloth, when the figure is printed on it. The price of these varies from 10 annas to Rs. 3.

Háthi is a piece of leather, 3 inches long by 2 inches broad, used to protect the printer's hand when striking the *dát* down to the cloth. On the corners of the strap there are strings to fasten it on to the hand and wrist.

Hiramji.—A flat oblong piece of iron with a wooden handle. It is used to scrape off dyeing substances when they get dry in the vessel containing them. It is about 4 inches long by 3 inches broad. Value one anna.

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* Another sort of *Tipai* is the three-legged table on which the cloth is spread out to be printed.

Nil ghisna is a piece of stone in the form of a cone with a spherical base. It is about 6 inches long. It is used in pounding indigo cake with water. Value 6 pies.

Mugri (mallet).—It is used for beating dyed cloth to give it a lustre. This operation is called in vernacular *kundi karna*. Price one anna. It is usually made of *imli* (tamarind) wood.

Patá is the block on which the cloth is laid to be thus beaten.